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### GERMANY AND AMERICA.

The visit of Prince Henry of Prussia serves to emphasize the good feeling which is entertained in this country toward Germany, a land from which so many of our best and most valuable citizens come, but which has in various unfortunate ways occupied a position more or less unfriendly. Those of us who happened to be on the Continent during or soon after the war with Spain could not dispute the evidence of our own senses in this respect, and with mingled pain and indignation had to endure contumely that was the more surprising when only friendship was expected. However, that period has closed, if we may judge from the hearty expressions of good will now emanating from Germany, while on our side the cordiality of the popular and official reception to Prince Henry is only another proof of our continuing admiration for the great German nation and for its high-minded ruler, that greatest of modern statesmen, the Emperor William. We believe that the Prince, who has won such golden opinions since he landed on our shores, will carry home with him further irresistible proofs of the desire of the United States to cultivate the closest amity with the German Empire.

Our trade relationships with Germany are very important, and many of the economic and social problems we have to solve have to be faced also in the Fatherland, under conditions of graver difficulty. With Germany we do a greater business than with any other country in the world, except the United Kingdom—a commerce which has grown since the close of the Civil War from $30,000,000 to just about $300,000,000. Trade which can be increased tenfold in less than 40 years is in itself the best of arguments for peace and friendship. Both countries have benefited by this intercourse, and on the face of it the division has been on very equal terms, for we took from Germany last year $100,000,000 of her manufactured products and sent her $192,000,000, largely in agricultural product, but including some characteristic American goods and apparatus, the chief item being $77,000,000 for raw cotton and $33,000,000 in corn and pork. In fact, the trade is likely to continue on such lines broadly if not interfered with by harsh and prohibitive tariffs.

Again, as our leading illustrated article this week shows—that on the new electric elevated and underground road in Berlin—Germany is meeting social and economic problems similar to our own, and is applying to them engineering genius second to none in the world. It is, indeed, from such examples that the two countries can learn most, and, as we have said, the visit of Prince Henry should be regarded as a sign that in the future they will be brought together more intimately by mutual respect and a closer understanding.

### A REMARKABLE CAREER.

We close this week Mr. Behrend's valuable discussion of the engineering work of C. E. L. Brown. It is a very striking resume of the debt that modern electrical developments owe to a single man. For the last 15 years Mr. Brown's name has been constantly before the public, and always in connection with something new and important. His work has been in great measure that of the pioneer, but distinguished from ordinary pioneering by the fact that he has not only blazed the path, but has cleared the country and left fertile fields behind him as monuments to his brilliant and thorough work. It is hard to tell at this epoch just how all his work will stand in the history of the electrical arts, but if his influence were stricken out from the development of the modern multipolar dynamo, the direct-

coupled slow-speed unit, the theory and practice of general power transmission, the induction motor and its application to railway working, and half a dozen other branches of electrical engineering, the world would be far poorer than it is and electrical industry far less advanced. Great designing skill, keen judgment and extraordinary practical common sense have marked his work throughout, and the blunders that can be charged to his account are uniquely few and small. Altogether, we feel that we do no injustice to the genius of our own countrymen or to their part in the world's electrical work in saying that no single engineer in this or any other country has in the past score of years done more to promote the substantial growth of electrical engineering, or to put electrical industry on a sound scientific basis than Charles Eugen Launcelot Brown.

### CARE OF LAMPS BY CUSTOMERS.

The advent of the Nernst lamp in the field of commercial lighting brings to the central station man some interesting questions as to just how these lamps are to be maintained, whether by the customer or by the electric light company. This was a matter brought up in the discussion at the last Northwestern Electrical Association meeting, and a variety of ideas were expressed as to what would be the proper way to maintain these lamps. One suggestion was to furnish the customer with all renewal parts free of charge and allow customers to make the renewals. Another was that the company should do all the work of maintenance, and still another that the lamps be sold outright and maintained by customers. The Nernst lamp is hardly far enough along yet in every-day use to enable these suggestions to be disposed of in a definite manner, but central station men will do well to remember, not only in introducing the Nernst lamp, but in connection with their present service, that it is convenience above all else that has led to the popularity of the electric light, which has won out almost entirely on this basis so far in its history. As a matter of actual expense, there are plenty of illuminants which are cheaper than the electric light for small customers, and which approach it even for the lighting of large stores and city streets; but when it comes to a question of convenience, freedom from annoyance and reliability, the electric light is so far ahead that it has won its way in spite of cost. Whatever a company can do to furnish a light that requires no attention whatever on the part of the consumer will put the electric light on that much firmer basis. The Welsbach lamp, for example, has had a very popular run, but the trouble of renewing mantles and lighting lamps has so militated against it that its use has been limited. Mr. H. L. Doherty struck the keynote in the discussion referred to when he said "The nearer you can come to giving people a light where they have simply to press the button and you do the rest, the more likely are you to retain their patronage. People do not want to be bothered in taking care of their own lamps, and the one thing to aim at is to give customers convenient service."

### WAVE PROPAGATION OVER NON-UNIFORM CONDUCTORS.

Dr. Pupin's admirable article on this subject, printed elsewhere in this issue, is practically an extension of his earlier analysis of non-uniform electric line conductors to include the case of leakage, with the addition of an elegant generalization of the analysis into a single mathematical expression from which special cases are capable of deduction. The deduction from the consideration of the influence of leakage is that whereas a perfectly insulated telephone line can be loaded with advantage to any reasonable desired degree, a leaky line cannot be loaded with advantage beyond a certain limit. While this limit is fortunately well within bounds as to commercial land and cable lines, yet it becomes desirable to maintain the insulation of loaded telephone conductors to the highest commercial standard, since a given leakiness will have more disadvantage in a loaded line than in an unloaded line. Referring to submarine cables with 0.3 microfarad and 5 ohms per mile, and an insulation resistance of 100 megohm-miles, the deduction of the article is that a proper artificial cable should be in lumps of inductance, capacity and insulation of 64 miles each. Incidentally, a submarine cable would be considered defective in insulation if after laying its insulation were as low as figured, and 1000 megohm-miles would be nearer actual conditions at one minute of electrification. It is, however, difficult to say just what the actual insulation of a cable is at an electrification of only one second, or a small fraction of a second.

Dr. Pupin, in the concluding portion of the article, points out that the theory of wave propagation over non-uniform conductors is, in its most general aspect, really nothing more than the extension of well-known engineering practice. That is to say, it has been known that in the case of transmission lines the inductance could not only be lumped but also placed at any point of the line. This, however, follows from the fact that the frequencies used on such lines are so low that the length of the corresponding wave is many times that of the line. The investigations of Dr. Pupin have shown that with high frequencies such as are used in telephony, a line may be divided into a number of sections corresponding in length to a sub-multiple of the highest useful wave-length or frequency employed, and then each of these sections loaded as in the case of an ordinary transmission line, in the latter case the whole of the line constituting but a single section with respect to a sufficient sub-multiple of the wave-length employed.

### THE HUMMING TELEPHONE.

A very instructive short paper on this subject appears in the current number of the British I. E. E. *Journal*. It is well known that when a telephone is connected in direct circuit with a microphone and battery, under certain conditions the telephone, if allowed to face the microphone, will sing a loud note. This tone is self-sustaining, since it is delivered into the microphone. The microphone and telephone may be said to carry on conversation in a loud, continuous monotone. The writer describes various experiments upon this self-sustaining tone. He draws attention to the remarkable fact that if the terminals of the telephone be reversed in the circuit the tone is markedly changed, the pitch at one direction of contacts being much higher than at the other direction. It is also pointed out that the pitch of the tone is affected by the impedance of the circuit. A rough measurement of capacity was capable of being made, by observing the pitch of the tone when a condenser was connected to the circuit. The theory outlined is that the case is one of forced vibrations in the telephone, as dependent upon the period of free vibration of the circuit. The effect appears to depend upon the length of the air-column between telephone and microphone, the free period of the circuit, and the free period or periods of the telephone diaphragm. In the appendix a number of interesting numerical data are given relating to the telephone apparatus used in the experiments. The amplitude of vibration of the telephone diaphragm is given as varying between one and seventeen microns.

### BRITISH I. E. E. INAUGURAL ADDRESSES.

The February number of the British Institution of Electrical Engineer's *Journal* has just made is appearance, and contains some interesting papers. Among the papers no less than five are inaugural addresses, the first being the inaugural address of the main body in London, and the others those of sections in Newcastle, Glasgow, Manchester and Birmingham. At the present indicated rate of increase in local sections, one trembles to think of the share of transactions which may, in the fulness of time, have to be devoted to inaugural addresses. The address of the main body in London is printed in the ordinary size of type, and the addresses of the sections

are in more subdued type. Most of them refer in some way, either directly or indirectly, to the reasons for the encroachment of foreign electrical manufacture upon British soil. An excellent abstract appears of the inaugural address of Dr. Lodge in Birmingham. Judging from this abstract it seems a pity that the address was not reported at greater length. It is evident that Dr. Lodge believes that electromagnetic inertia of ions may be found to account in full for the observed inertia of matter.

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An excellent paper is contributed by the Calcutta section. This deals largely with the effect of the East Indian climate on insulation. The intense humidity and relatively high temperature of the air make good insulation difficult to maintain. The casualty list appears to be very heavy in 225-volt fan motors, but this is not to be wondered at, considering the climate and the duty. One particular fan motor, operated by the writer of the paper, is stated to have been run for three months continuously without turning off the current. Of such is the climate of Bengal. It transpired through the subsequent discussion that overhead bare copper wires are occasionally apt to be crossed by flying foxes, small animals, about 18 inches long, indigenous to those localities, so that just as in some districts of California, overhead wires have to be mounted at safe "eagle distance" from one another, so it appears that in some districts of Bengal wires are mounted at safe "flying-fox distance."

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### THE NEGATIVE BOOSTER.

A recent paper by Kapp abstracted in the Digest last week takes up anew the always troublesome problem of avoiding electrolysis. His present plan is a modification of the general "current-pump" idea, based upon using negative boosters to assist the current's faltering footsteps homeward. The present practice is to tap the rails at various points by return lines through which reversed boosters, operated by current from the positive feeders, assist the returning current. The expedient is effective but costly, and Kapp suggests for long lines the use of negative boosters cut directly into the rail circuit to keep the return current "on the run," so to speak, too actively to permit of much straying. The suggestion is interesting, and while the process would seem to be less effective than the usual one, its simplicity commends it for use within a limited field. The longer lines, particularly interurban lines, are in our own country at least not much afflicted by electrolysis as compared with urban systems, and in many cases no unusual devices are needed. Sometimes, however, local conditions exist which call for action, and here either of the booster devices referred to, or both of them, may prove useful. The whole matter of electrolysis is in rather a curious state just at present. A few years ago the matter was so stirred up as to cause a very undue amount of anxiety and excitement. An analysis of the whole body of complaints received would in nearly every instance show that the moving cause was less the actual damage than the desire of some one to gratify a grudge against a traction company or to exploit some premature device. Real injury has, of course, been done in many cases, but with the later investigations of the matter it has become evident that such injury has been far less severe and widespread than was supposed a few years ago. Thorough bonding has done much to lessen trouble of this character, and it is now usually found to be very local in its manifestations

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### THE OSMIUM LAMP.

The Digest of last week contained an interesting account of the performance of the osmium lamp to which we have several times called attention. On its face the performance is most striking. A life of more than 1000 hours at a nearly uniform economy of a trifle less than 1.5 watts per candle is certainly most sensational. From the curves shown it would appear that the osmium filament ends its usefulness not so much by decay as by breakage, since the light and efficiency seem to hold up well almost to the end. This being so, it is of interest to inquire into the average life of such filaments, and the answer given is that at 1.5 watts per candle the life is at least as great as that of a 3-watt carbon filament. This is encouraging so far as it goes, but a trifle vague. If the statement refers to the ultimate life of a so-called 3-watt lamp the result is phenomenal, but if, as seems altogether probable from the data presented, it refers to the normal useful life of a 3-watt lamp, the case is materially altered. For this life is but 400 to 500 hours at most in lamps as now ordinarily used; i. e., at the end of this time the lamp has so far run down in efficiency and candle-power that it should be scrapped. Life in candle-hours is the real criterion of usefulness. An incandescent lamp equal in this particular to the best now in use and working steadily at 1.5 watts per candle would entirely change the situation in electric lighting, provided that the cost of lamp per candle-hour were not unreasonably great. So far as one can judge, fragility seems to be the weak point of the osmium filament, so that it has not yet proved possible to make a practicable lamp for 100 volts; 50 volts seems a far more feasible figure, and lamps for 10 or 20 volts are inferentially suggested for commercial use. The filaments from which the remarkable life curves are derived appear to be computed from the data given, for about 22 volts.

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This low voltage for a lamp of moderate candle at once suggests some serious practical difficulties. Lamps connected in series have always been rather unpopular and require extraordinary uniformity in manufacture to secure good operative conditions, even putting aside the question of inconvenience in case of breakage. Osmium is about as intractable a material as could be found. Not only is it nearly infusible, but it is troublesome and dangerous to work with, and is only semi-metallic at best. Hence the manufacture of osmium filaments can hardly be improved without limit, and the chance of getting a good lamp for ordinary voltages seem very remote. A far more serious practical question, as we intimated some time since, is that of cost. Osmium is formed in platinum ores in the form of an alloy with iridium. This alloy contains from 25 to 40 per cent of osmium, and is present in platinum ores generally in very small proportion, the Ural ores from which most of our commercial platinum is derived carrying less than one per cent of osmiridium. Only in certain platinum ores themselves small in aggregate amount, does osmiridium occur in reasonably large proportion, 25 per cent or thereabouts. It would be well within bounds to say that osmium is 100 times as scarce as platinum. It is at present used in very small amounts as a chemical reagent. When one considers the tremendous increase in the price of platinum produced by its use for the leading in wires of incandescent lamps, and the enormous sensitiveness of rare materials to the law of supply and demand, it is obvious that unless some new and fruitful source of osmium should be discovered, the cost of the material would rise to a prohibitive amount at the first material indication of commercial use. Of course, the osmium would be recoverable from burned-out lamps, but so is platinum, else its cost would be far greater than even the present high figure. There seems, therefore, good reason to believe that even were the osmium incandescent lamp to fulfil all the ordinary commercial requirements which seems in itself doubtful, it would have to encounter a difficulty which seems insurmountable in the extreme rarity of the material. Of course, then would ensue such a hunt for iridosmium as not even the rush for the Klondike could equal, but the conditions of its occurrence are not such as to encourage hope. Still, the osmium lamp is another link in the chain of improved illuminants, and whether it succeeds or fails it may operate to bring nearer the day of more efficient illuminants than we now have.

## A Prince Among "Captains of Industry."

One of the most interesting features of the presence of Prince Henry of Prussia in New York has been the breakfast given on Wednesday of this week at Sherry's by 12 leading American citizens to enable him to meet the country's "captains of industry" and those who, by invention and skill, have helped to place the United States in the position it now occupies in all the arts and in all branches of commerce. The hosts were: J. P. Morgan, E. D. Adams, A. E. Orr, G. F. Baker, W. Rockefeller, L. P. Morton, A. S. Hewitt, M. K. Jesup, E. H. Gary, John Claflin, J. Stillman, W. K. Vanderbilt, aided by Mr. L. M. Goldberger, who is now in this country on behalf of the German Government, investigating industrial conditions. These, with their guests, numbered 144, seated at 11 tables, of which 10 faced the table at which sat the Prince and his hosts. The breakfast was given in the ballroom, with the utmost luxury, but in the quietest good taste, the aim being to make the affair as nearly as possible devoid of ostentation and display. The management and preparations were largely in the hands of Mr. Edward D. Adams, the banker, financier and railroad manager, famous for his development of the Niagara power enterprise, and who has also represented the German Government, the Deutsche Bank and Siemens & Halske in this country. The electrical arts and industries were most flatteringly recognized in the persons of George Westinghouse, Thomas A. Edison, Frank J. Sprague, Professor F. B. Crocker, Professor Elihu Thomson, Dr. M. I. Pupin, C. M. Hall, Alex Graham Bell, C. F. Brush, Edward Weston, E. G. Acheson, H. H. Vreeland, Alex E. Brown, E. W. Bliss, C. A. Moore, Dr. H. Morton, P. A. B. Widener, J. Ogden Armour, Edwin Reynolds, George G. Ward, John Markle, George J. Gould, W. A. Roebling, Professor R. H. Thurston, Coleman Sellers and Nikola Tesla.

## Electrical Engineers of the Day—XXXV.

H. H. Wait.

Mr. Henry Heilman Wait was born in Chicago, Oct. 27, 1869. His first training, from a technical standpoint, was at the Chicago Manual Training School, which he entered with its first class, graduating at the age of 16. His practical electrical work began while at the Manual Training School during vacations. A large amount of building was at that time under way in the residence districts of Chicago, and as there was a large demand for electrical work, Mr. Wait appreciated his opportunity and secured a number of wiring contracts which he completed in a very satisfactory manner. This experience fixed strongly his determination to become an electrical engineer.

With this in mind he went to the Massachusetts Institute of Technology at Boston, taking the course in electrical engineering from which he was graduated in 1891. His vacations were profitably spent in visiting and investigating various manufacturing establishments in this country. Desiring to also understand European methods in the electrical industries, he went abroad during the summer of 1890, and in an extensive tour visited many electrical plants, both in England and on the continent.

After graduation from the Institute, Mr. Wait entered the employ of the Economic Electric Manufacturing Company, of Brockton, Mass., an establishment manufacturing chiefly incandescent lamps, although it also did a small business in dynamos built from the designs made by Professor Hooper, of Tuft's College. The exigencies of a small establishment gave experience in all sorts of work, including the design of photometric apparatus and semi-automatic devices for making and measuring lamp filaments. In conjunction with Lieutenant H. P. Huse, U. S. N., who was on special leave of absence to study incandescent lamps, he developed curves and formulæ for the predetermination of the approximate action of lamp filaments, which proved highly valuable at that time.

In 1892 Mr. Wait returned to Chicago, where he entered the drafting department of the Western Electric Company. In this position he remained the best part of the year, but his abilities brought him quickly to the front, and he soon became assistant to Mr. E. P. Warner, chief electrical engineer of the light and power department. At this time most dynamos were of the bipolar type, and Messrs. Warner and Wait redesigned the entire line of machines as built by the company, and as soon as these were completed, designed a line of multipolar machines, which at that time were just beginning to be used.

In 1894 Mr. Wait made a radical departure in the design of arc-light machines, bringing out the now well known 100-light W. E. arc machine for the municipal plant in Detroit. Mr. Alexander Dow, the engineer of the Detroit plant, was severely criticised at that time for specifying machinery so far in advance of current practice, but it proved to be a success from the start, and justified Mr. Dow and the manufacturers for this step in advance. This machine had a surface wound Gramme armature, but realizing that the use of an iron-clad armature could be utilized for arc machines, as well as for constant potential generators, Mr. Wait completed a line of iron-clad arc machines. He was successful in developing insulation which would be suitable for such high voltage windings, enabling the machines to stand continual service without burning out. The successful solution of this difficult problem at that time gave Mr. Wait a wide reputation, especially in the West.

In 1896 Mr. Wait began the design of a line of enclosed and open motors with interchangeable parts, adapted for application to machine shops and similar work, following this up slightly later with a line of elevator motors. These latter machines had iron-clad armatures and were of unusual proportions in their electrical designs, producing results as to starting current and other elevator characteristics, which at that time were entirely new. Along with this work Mr. Wait designed a line of direct-current fan motors on which much care and thought was expended, resulting in the well-known Western

Electric fan motor. It is probable that the standard requirements for this class of machinery were in general much advanced by the introduction of these motors.

In 1900 the Western Electric Company brought out, from Mr. Wait's designs, their type L multipolar direct-current generators and motors, these machines being built in sizes ranging from 10 to 1000 kw, and adapted for both lighting and railway work. They are known especially for their peculiar form of armature winding, which makes it possible to obtain normal results with a machine of dimensions considerably below the usual size. This is accomplished by means of a continuous-bar winding, which has enlarged ends, but reduced cross section in the slots. By this means it is possible to keep the resistance of the armature low, and at the same time reduce the size of the slots, insuring a stable field and small armature reaction.

Mr. Wait is a patentee of numerous inventions on dynamo designs and special machinery for manufacturing the same. Among these may be mentioned a varipolar motor for dynamos and a semi-automatic machine for winding small armatures, spools, etc., which has done much to cheapen the cost of such work. In conjunction with Mr. Warner he has also been granted patents relating to the well-known Western Electric type of arc lamp.

In December, 1899, Mr. Wait read a paper before the American Institute of Electrical Engineers, of which he has been a member since 1893, on "Cost of Arc Lighting by Means of Various Systems." The features applying to street illumination were afterwards amplified and given in a paper before the Northwestern Electrical Association.

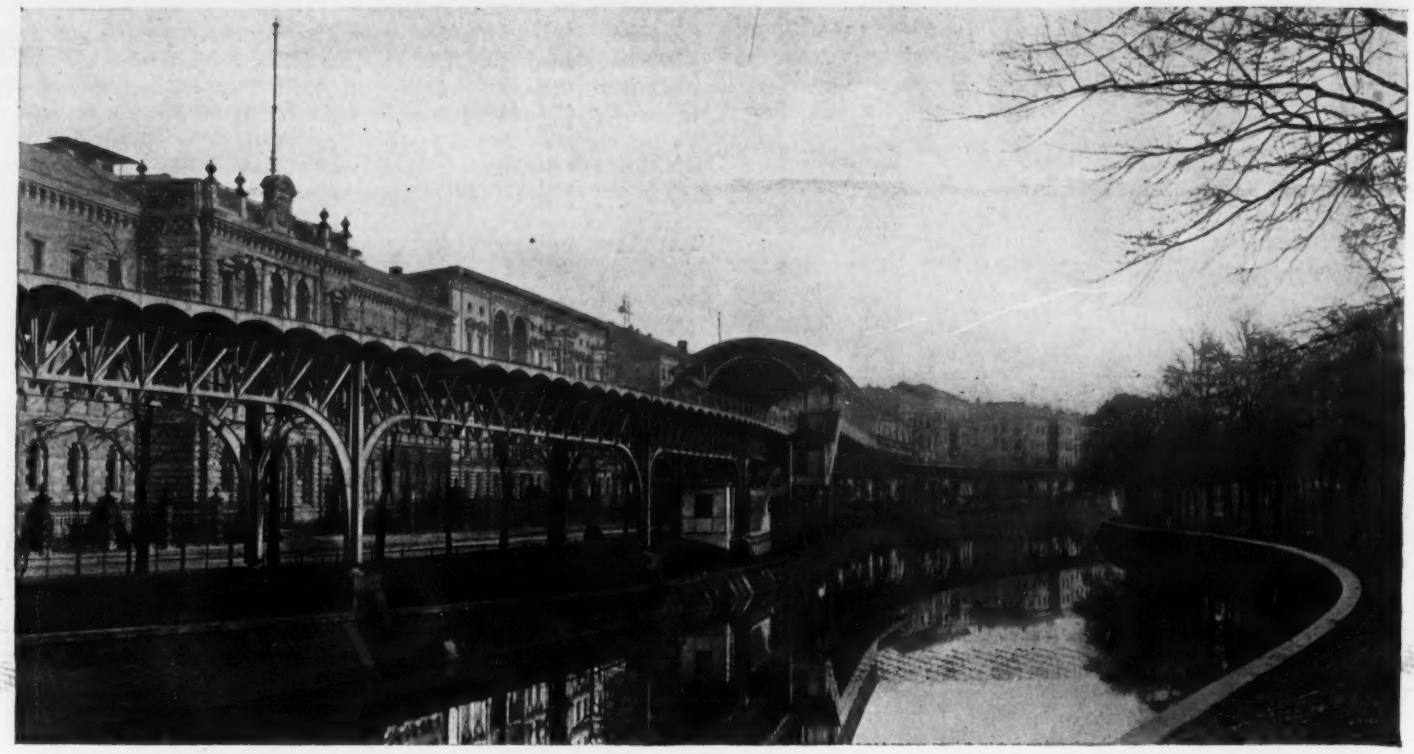


FIG. 1.—ELEVATED ROAD AND STATION ON CANAL BANK.

## Opening of the Electric Elevated and Underground Road, Berlin, Germany.

WITH due celebrations and solemnities, the new elevated and underground electric railway at Berlin, Germany, was opened on Feb. 15. It forms an important addition to the rapid transit facilities of that great city, and is of more than usual interest at a time when cities like New York, London, Paris, Boston—in fact, all the great modern centers of population—are struggling with the same problems of inadequate transportation. The cities of the Old World equally with those of the New have turned to electricity in the hope of affording the local public better service, and

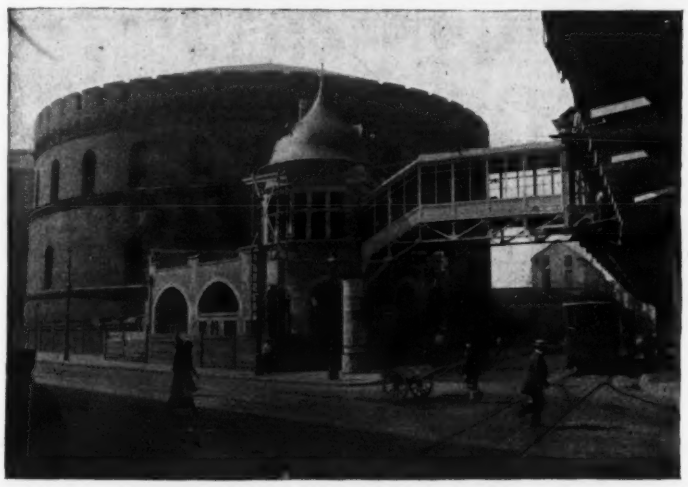


FIG. 2.—ENTRANCE TO THE PRINZESSENSTRASSE STATION.

of late have left the surface to try conclusions by adopting either elevated lines or underground service, or both.

It is not necessary here to discuss the earlier formative stages of this work, but we may note that Siemens & Halske transferred to a new company the franchise rights it had secured for this work, and that in 1897 the State and municipality gave to this company the right of way under a 90-year franchise from the Warschauer Bridge to the Zoological Gardens, with a spur or loop to the Potsdam Station, the network being shown on the accompanying map. For this concession the company has agreed to pay 2 per cent on yearly receipts up to 6,000,000 marks; 2½ up to seven, and ¼ per cent for each additional million, with a minimum of 20,000 marks at the end of the first four years. The city of Schoneberg also comes in for a nibble, getting from 8-36 up to 9-36, and an additional 1-36 for each million, and a minimum of 3500 marks. Right of purchase is reserved after 30, but not after 40 years.

The Siemens & Halske Company agreed to build and equip the road at its own risk and run it one year for a guaranteed 4 per cent net, and 25 per cent of any profit above the 4 per cent; and presumably this part of the arrangement is now in operation. The total length of the road is 10.4 km. It is standard guage and double track. The roadbed has a width of about 7 m. At several points the road has sharp curves, one in the switchback at the Potsdam Station having a radius of 90 m., and another 80 m. The curved portion of the road is 27 per cent of the whole. The pillars of the structure are never less than 2.8 m. in height from the street level. In general, the super-

FIG. 3.—GORLITZER STATION.

structure is of iron and steel. The entire structure is lined with sheet iron covered with gravel, etc., in such a manner as to prevent those drippings to the street which are such a disagreeable feature of the elevated roads in New York and Chicago. Views are shown herewith of part of the metal structure and also of the stone viaducts and bridges employed at various points. The road has been kept very level, there being no steeper grade than 1.38. There are 13 stations on the line, and the average distance between them is 930 m. Th maximum speed permitted is 50 km. per hour. The stations are unusually handsome and substantial buildings, as will be seen from the photographs and drawings; indeed, they look too large for their duty; but this is a fault of which the passengers rush-

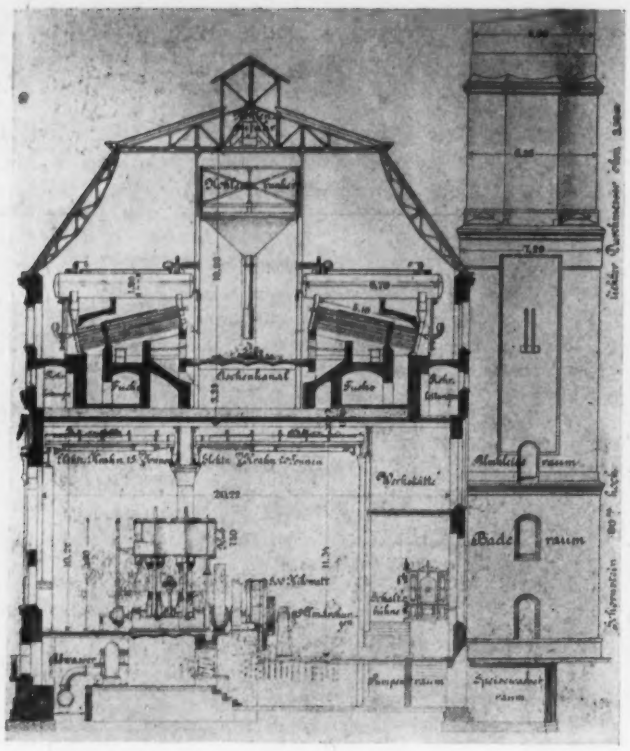


FIG. 4.—CROSS SECTION OF POWER HOUSE.

of 100 amperes up to 140 amperes. The motor cars accommodate 40 passengers, and the trailers 60, so that an ordinary three-car train will seat 140 people. The cars have longitudinal seats. A hand brake is provided, although it is proposed to use magnetic brakes. It is intended that the trains shall have a 5-minute headway, at which we presume the road has started operation. The normal speed is put at 30 km. per hour.

The power house, of which a cross-section view is shown, contains

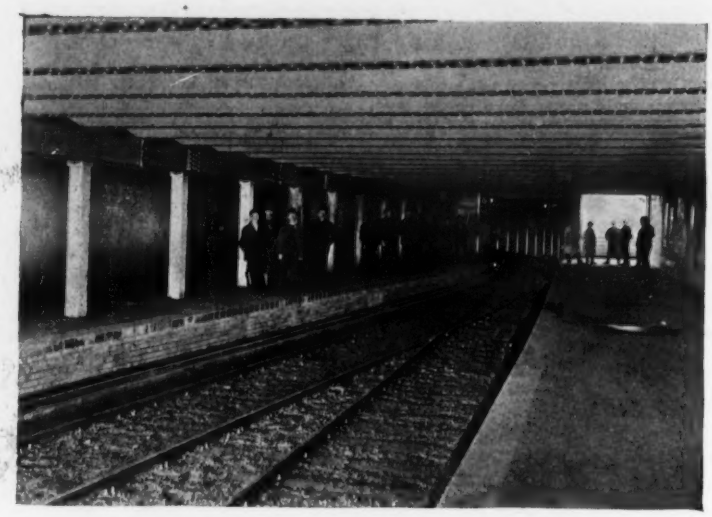


FIG. 6.—UNDERGROUND STATION AT POTSDAMER PLATZ, SHOWING THIRD RAIL.

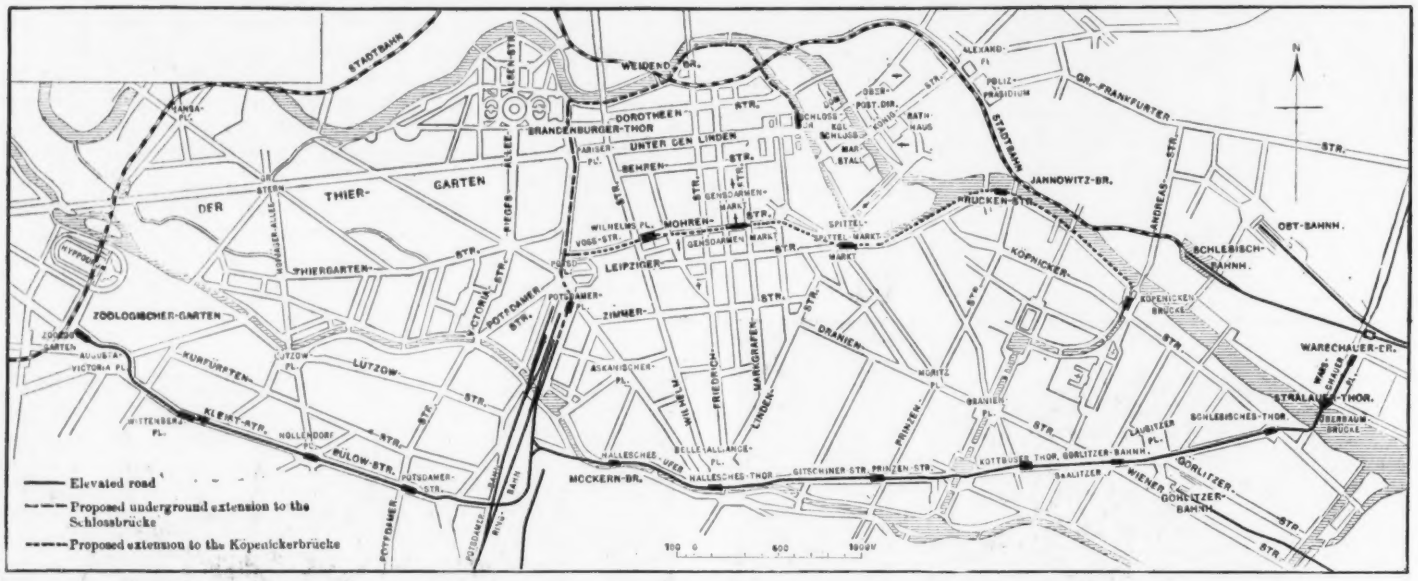



FIG. 5.—MAP OF NEW ELECTRIC ELEVATED AND UNDERGROUND ROAD, BERLIN.

ing in and out of them will never complain. The platforms are 3 m. in width, and the overhead shelter is ample. The largest station, the terminal at the Warsaw Bridge, is 300 m. in length and 26.5 m. in width. Besides the depot, which is 50 m. in length, with three platforms each, 80 m. long, there is a car barn, which will store 12 trains. There are also car shops at this point.

The underground portion of the road, or tunnels, are excavated along the main streets, and then covered in, somewhat as in the shallower sections of the Paris Metropolitan along the Rue de Rivoli. The transverse concrete arches are 22 cm. thick at the crown, the surface of the road being about 60 cm. higher than that. The arches are of cement concrete, on wooden centerings, and the distance between the transverse girders is about 1½ m. The rise of the arch is 20 cm. The width of the subway is 6¼ m. A view is shown herewith of one of the three underground stations, taken just before the opening of the road, and showing at one side the third rail resting on its insulators.

The trains will consist of two motor cars and one ordinary car. The motor cars run on two bogies, and each of the four axles is driven by a single reduction motor wound for 750 volts and a current

FIG. 7.—ARCADE STRUCTURE AT BRIDGE OVER THE SPREE.

three vertical 1200-hp engines, built by Borsig, each coupled to a Siemens & Halske 800-kw vertical pole generator, with 10 poles. The power house was designed by Mr. Wittig, engineer of the company. As will be noted the boiler room is above the dynamo room. It is equipped with six Gehre water tube boilers, and above the boilers are sheet iron pockets and funnels by which the coal is delivered automatically to the furnaces, the coal being transferred from canalboats by Hunt conveyers. Feed water is drawn from the Landwehr Canal. The smokestack is 80 m. high, or 7 m. higher than the tallest building in Berlin, the City Hall. Steam is furnished at a pressure of 10 atmospheres, and with 200 degs. C. superheat. We hope to furnish further details at an early date of this interesting system, which has now gone into service.

## A Modified Wehnelt Interrupter.

BY PROF. A. L. FOLEY AND R. E. NYSWANDER.

THE form of interrupter herein described has been used in the Indiana University Physics Laboratory for more than two years, and has given better results with less trouble than have other interrupters of the electrolytic type.

A block of wood some 3 cm. thick and 15 cm. square has a hole, about 1 cm. deep, bored or turned in it to receive the cell *c* (Fig. 1), which is made of lead, and which serves as the cathode. The lead cell rests upon a plate *p* of sheet lead, which lines the bottom of the hole and which is connected to a binding post not shown in the figure. Thus the cell can be removed and replaced without interfering with the electrical connection.

A second binding screw is connected with the vertical tube *T*, and hence with the platinum wire anode. The brass tube *T* has a slit cut lengthwise through one wall at its upper end, and extending downward to within 2 or 3 cm. of the top of the cell. This slit permits of the vertical motion of the rod *a*, which passes through it, and it prevents any horizontal motion. Thus the anode is held in the center of the cathode cell, and there is no danger of short circuiting by the arm swinging around and bringing the tube and cell into contact. When removing and replacing the cell, the arm *a* may be lifted entirely out of the slit, turned horizontally, and allowed to rest on the upper end of the tube *T*.

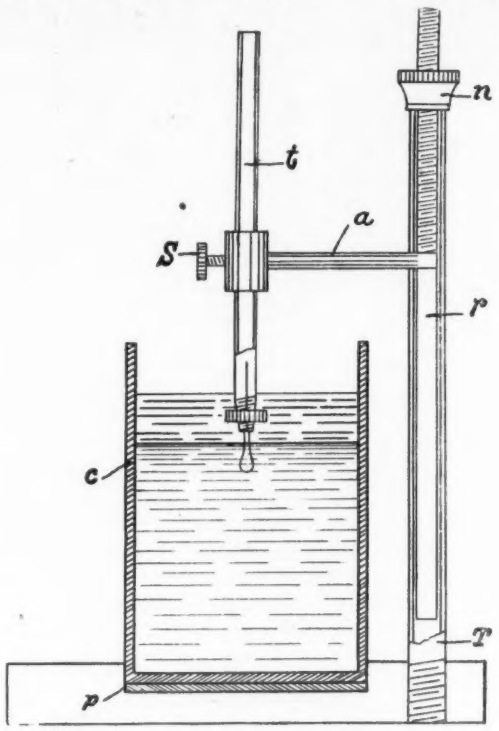



FIG. 1.—DIAGRAM OF INTERRUPTER.

The arm *a* is carried by a vertical rod *r* fitting snugly the tube *T*. The rod is threaded for several cm. at its upper end, and its position in the tube is controlled by a thumb-nut *n*. The arm *a* supports a rod *t* through which a hole is bored to within 1 cm. of the lower end. This end is tapered and threaded. Two slits at right angles to one another are sawed through the axis of the cone, forming four jaws, which hold the platinum wire anode. A nut threading on the cone serves to clamp the wire firmly. The hole in the rod permits the use of platinum wires of any length.

The lead cell is partially filled with the electrolyte and a layer of kerosene 3 or 4 cm. thick is poured over it. The platinum wire, which may be single, double or in the form of a loop, is clamped so that it projects a cm. or so below the end of the rod. By means of the set-screw *s* the tube is adjusted so that the platinum wire dips a few mm. in the electrolyte, when, upon closing the electric circuit, the interruptions should begin. The nut *n* gives a more delicate adjustment of the depth of the wire, which should depend on the nature of the electrolyte, size of the platinum wire, voltage, inductance and size of the lead cell. The latter is 7 cm. in diameter and 14 cm. high.

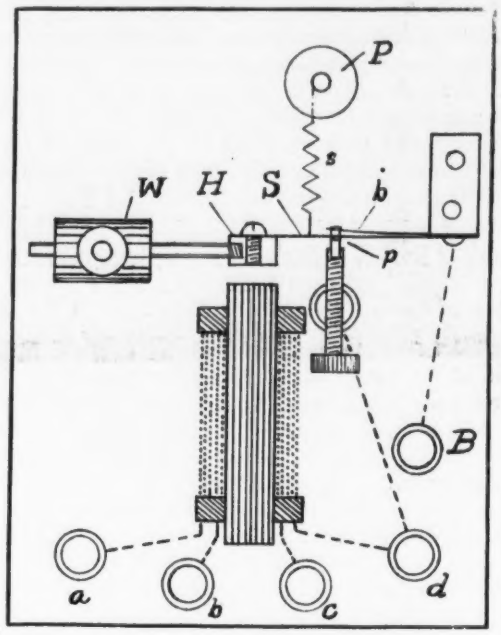



FIG. 2.—MAKE-AND-BREAK DEVICE.

The kerosene keeps down the temperature of the portion of the wire not in the electrolyte,[1] so it makes little difference in the action of the interrupter how much wire projects below the end of the rod, provided it is all in the oil. However, the heat generated in the kerosene is wasted energy and by it the temperature of the cell is unnecessarily increased. The kerosene tends also to decrease the fumes and spray from the electrolyte.

When long-continued use of the interrupter is required it will be necessary to have, in connection with the lead cell, a cooling coil or jacket. Where the interrupter is to be used for only a few minutes at a time with several minutes' rest between times, the plain cell will suffice. In our work, where the interrupter was in action during half the time for periods of 2 or 3 hours, we found that the temperature could be kept sufficiently low by soldering or leading to the cell some 35 vertical, radial, equally spaced vanes. The vanes were made of copper strips about .15 cm. thick, 3 cm. wide, and long enough to reach from the upper edge of the cell to within 2 cm. of the lower edge.

One of the difficulties of the Wehnelt interrupter, particularly in using certain electrolytes, is that the action may cease at any moment. With some electrolytes, a 5 per cent solution of caustic potash for instance, the action is usually resumed without attention from the operator. This is not true in most cases, as with a 20 per cent solution of sulphuric acid, a 10 per cent solution of potassium-sulphate, or a warm potassium-nitrate solution. It has been found that, to make the interrupter resume, the circuit must be broken and connection again made. A momentary break is sufficient, and so the device of Fig. 2 was constructed to break and make the circuit automatically. It might be thought of as a make-and-break, which works backwards.

An electromagnet with laminated core has two sets of coils with terminals brought to the four binding posts *a, b, c, d*. The magnetizing coils may be connected singly, in multiple, or in series, thus giving the instrument considerable range as to magnetizing current.

The instrument is connected in series (binding post *B* and one of the others) with the interrupter. When the current is passing and

[1]This point is mentioned by Rossi, *Accad. Sci. Torino Mem.*, 34, 1899. The above described interrupter was in use in the Indiana University Laboratory several months before Rossi's article appeared.

the interrupter is in action, the hammer *H* is drawn to the core, against the action of the flat spring *S* and the spiral spring *s*, the latter of which can be controlled by the screw *P*. The moment the action of the interrupter ceases the current is so far diminished that the springs pull the hammer from the core. The inertia of the weight *W* carries the vibrator beyond its normal position, it strikes the break spring *b* and the circuit is broken between the platinum points at *p*. As the vibrator returns the circuit is completed, the interrupter begins to act, and the hammer is again drawn to the core.

The authors have studied the action of the interrupter with some 50 different electrolytes, some of which work better on high and low voltages than the usual 10 per cent solution of sulphuric acid. The addition of nitric acid to the sulphuric acid solution lowers the voltage required to produce interruptions. The writers use a 10 per cent solution of sodium sulphite on a 115-volt circuit without any other resistance. The discharge was exceedingly heavy and of high frequency. It was noticed that, with a solution of hyposulphite of soda, the interrupter ceased working when the secondary of the induction coil was short circuited, while a solution of ammonium nitrate worked best on a short circuit.

## Slaby-Arco Wireless Telegraph Apparatus.

BY A. FREDERICK COLLINS.

AT the successful conclusion of the tests for the German Government, of the system of wireless telegraphy designed by Count d'Arco and Dr. A. Slaby, of Charlottenburg, negotiations were entered into and consummated by the Allegemeine Electricitats Gesellschaft (General Electric Company), of Berlin, to construct and supply the apparatus.

This system of wireless telegraphy was originally designed with special reference to obtaining a tuned or syntonic method, and there are three types of the apparatus now manufactured—the permanent station apparatus, the portable field equipment and a modification of the standard set adopted especially for war vessels.

The theory upon which the Slaby-Arco sets are constructed is well known, having been published in detail in previous issues of ELECTRICAL WORLD AND ENGINEER, and I shall, therefore, confine myself to an account of the apparatus employed.

In the permanent station type shown photographically in Fig. 1 and diagrammatically in Fig. 2, the current is supplied from 110 or 220 volts, direct current. The Ruhmkorff coil (Figs. 1, 2 and 3) is enclosed in a box and sets under the table. A mercury turbine interrupter 2 is employed to insure a uniform and rapid "make-and-break" (Fig. 2). It is driven by a small motor, 3, and to regulate the number of revolutions there is a sliding resistance, 4. By this means any number of interruptions may be had at the will of the operator from 10 to 10,000 per minute.

In circuit with the primary winding of the coil or inductor, is the interrupter, one or two high-potential condensers, 5, a Morse key, with platinum contact points, 6, and a resistance, 7, for regulating the primary inductance. The terminals, 8 and $8_2$ (Fig. 2), are connected with the binding posts, $8_1$ and $8_2$ (Fig. 3). The binding posts of the regulating resistance, 7 (Fig. 2), are connected, as shown, to the terminals, $8_1$ and $8_2$. The two other binding posts of the resistance, 7, are connected with the inductor terminal, $2_1$, and the other carries the current through the turbine interrupter, 2, and the Morse key, 6, to the second terminal of the primary winding, $2_2$.

This Dr. Slaby terms the low-tension circuit. The condenser, 5, is connected parallel to the interrupter. The terminals, $8_1$ and $8_2$, are connected by the sliding resistance, 4, to the motor, 3. In order to protect the dynamo generating the current from lightning, which might strike the antennæ, *A* (Fig. 3), a special lightning rod or conducter, shown by the arrow in Fig. 2, is used by way of equalizing the high-potential between the apparatus and the ground.

The high-tension circuit consists of the secondary coil of the Ruhmkorff (Fig. 3), with the binding posts, $8_1$ and $8_2$, a battery of Leyden jars, 9, a tuning coil, 10, and the antennæ, *A*, which, according to a literal translation from the German text of Slaby, is a transmitter conductor. The terminals of the oscillator system may consist of two points or of two balls 3 mm. in diameter. One of the poles of the spark-gap, 14, is connected with the inductor by $8_1$. (Fig. 2). The opposite terminal, $8_2$, is connected by the binding post, 11, to the earth at *B*. A well insulated rubber-covered wire connects the spark-gap with the plug plate, 12, of the battery of electric jars, 9, which consists usually of three Leyden jars placed in a cylindrical box made of pasteboard. The inner coating is carried by a rubber covered wire with plug connections to the plug or connecting plate, 12, and is insulated from the upper cover by hard rubber. The outer coatings are connected by a tinfoil coating at the bottom of the jars to binding posts of the box, 13.

The tuning or syntonizing coil, 10, is wound on the outer side of the cylinder of pasteboard forming the box of the battery. It is formed of four or more turns of No. 12 wire, connected with the binding post, 13, and the binding post, $8_2$. The binding post, 13, is also connected with the antennæ, *A*, and by this means it is grounded through the tuning coil earthed at *B*.

According to the Slaby theory the antennæ, *A*, has only a small amplitude of vibration near the ground, while its greatest amplitude of vibration is near the top, and for this reason any lightning rod may be employed as an emitter for the electric waves without the possibility of any fatal physiological effects. The transmitter is shown schematically in Fig. 4.

The receiver consists of (*a*) the light current circuit, (*b*) the heavy current circuit and (*c*) the electric wave system. In practice, the wires of the light current circuit are surrounded with white insulation, and those of the heavy circuit with black insulation, thus it is apparent at a glance, to which circuit the wires belong. In the light current circuit are the coherer, the tapper or jigger, the coherer cell for operating the relay, the relay, the condensers which are connected in parallel to the cell and the circuit and the switch for the antennæ connecting it with the coherer.

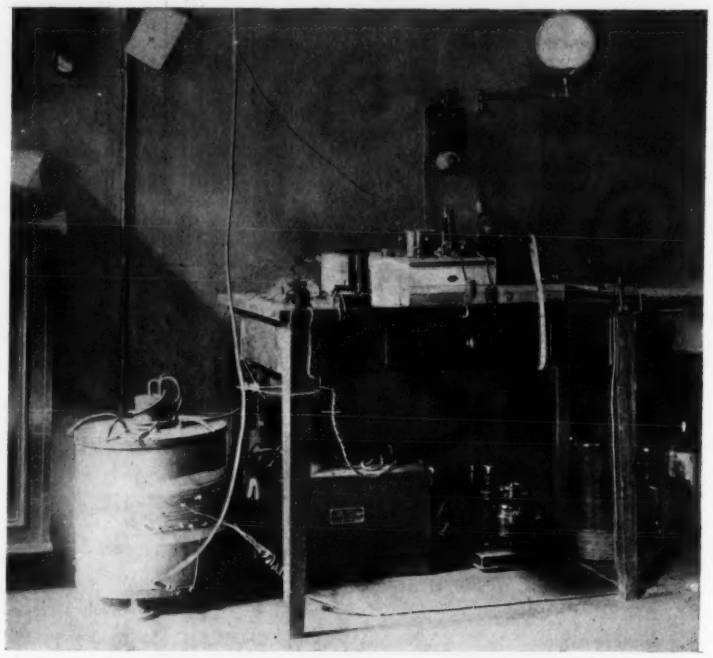


FIG. 1.—GENERAL VIEW OF STATION APPARATUS.

The coherer tube is exhausted to protect the filings from oxidization, and that they may at all times remain dry and movable. This permits the grouping of the filings in the same manner after each stroke of the tapper. The plugs of the coherer are made of silver and connect with platinum terminals sealed in the tube and attached to metal caps fastened to the coherer with gypsum, as in a Geissler tube. This is to prevent the connecting wires from breaking off. The capacity of the coherer is about 0.0001 microfarad.

It will be observed that the end surfaces of the conductor plugs of the coherer are not parallel, but wedge-shaped. This "split" of the coherer allows its sensitiveness to be regulated, though the tube is exhausted and sealed. If the position of the tube is such that the narrow part of the split is down, the filings assume a vertical position, the pressure is increased by gravity and the sensitivenes is at its maximum value. If the broad part of the split points downward, the filings are spread lengthwise, the pressure is diminished and the sensitiveness decreased. The coherer may be placed in different positions by an adjusting wheel and locked with a catch spring, when the desired sensitiveness is obtained. The metal caps make the exchange of coherers a simple matter. It is not claimed that these coherers are very sensitive, but their precision may be relied upon.

By moving the tapper-lever the light-current circuit is made, and

the current from the cell is cut off from the coherer. The advantages of this arrangement are (1) an easier and more exact interruption, (2) greater duration of life of the coherer, (3) exclusion of the sparks through the coherer, and (4) non-inductive resistances usually connected in parallel with the interupter are not necessary.

The coherer cell is a dry battery, having an e. m. f. between 1.2 volts and 0.4 volt. If the voltage is higher than 1.2 the coherer does not work with the requisite precision. If the voltage is less than 0.4 volt the e. m. f. is not sufficient to operate the relay. The relay is wound to a resistance of 2000 ohms to correspond to the normal resistance of 2000 ohms of the coherer when in operation. The relay is polarized, and works in the following manner: A permanent magnet of steel magnetizes the cores of the coils which are of soft iron, the pole pieces being magnetized to the same sign. The permanent magnet likewise magnetizes a tongue of soft iron between the pole pieces to the opposite sign of polarity. This armature or tongue is forced into a fixed position by two contacts $K_1$ and $K_2$. $K_1$ is a stationary contact and $K_2$ is an operative or working contact. By

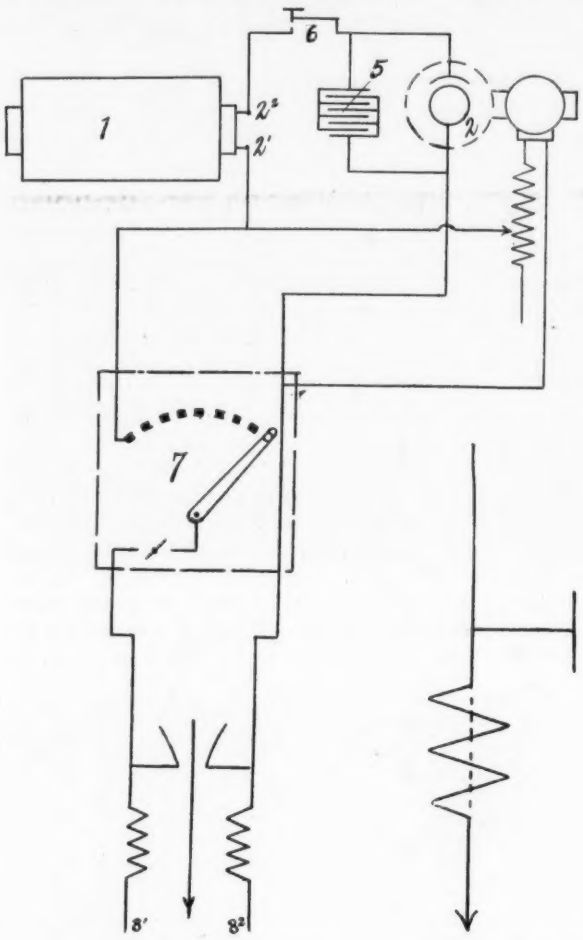



FIG. 2.—LOW-TENSION CIRCUIT TRANSMITTER.

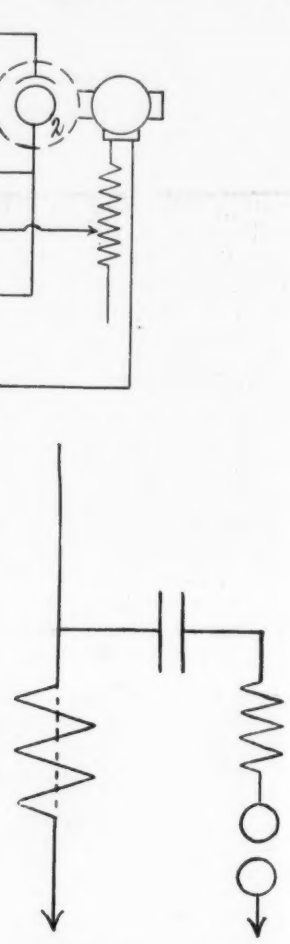


FIG. 4.—DIAGRAM OF TRANSMITTER CIRCUITS.

changing the position of $K_1$ and $K_2$ the tongue is brought into an unstable magnetic equilibrium. The magnetism of the iron coils is now changed as the light current coming from the coherer cell is carried through the relay coils. The original magnetism of one core is strengthened and the magnetism of the other core is weakened proportionately. By this means the equilibrium of the tongue is disturbed and the tongue strikes the fixed contact. The relay tongue is balanced for each position by a counterweight, and this enables the relay to work well, even if the whole apparatus is in a vertical position.

The condenser is connected in parallel to the dry cell and the relay circuit. It has a capacity of 0.01 microfarad, and is of the standard mica type. It has a dual purpose. First, it takes up the excess of tension exerted on the coherer, originating from the self-induction of the relay coils, and so facilitates decohesion; second, the condenser connects the "ground" with the coherer through the tapper avoiding the self-inductance of the relay.

The regulating resistance is intended to weaken the strength of the receiving current where the stations are very near to each other. By operating the resistance the tuning is disturbed and the force of the waves reaching the coherer is diminished. There is a switch to protect the coherer while transmitting from the strong radiation in such close proximity, from the spark-gap of the transmitting coil of its own station. By a special device all metal parts are removed from the coherer, diminishing the possibility of electric waves in the neighborhood acting on it.

A second advantage of this switch is that of changing the antennæ from transmitting into a receiving wire by only one movement, that of opening the switch, when all connections to the receiving apparatus are broken, those to the coherer as well as to the antennæ. The switch has two binding posts, connected with each other if the switch is open, disconnected if the switch is closed. The primary current of the inductor passes through these posts. By this the inductor gets no current and no spark is produced if the Morse key is moved down, and the operator should have forgotten to open the coherer switch.

The heavy current circuit consists of (*a*) the heavy current battery, (*b*) the tapper, (*c*) the working contact of the relay $K_2$ and the tongue (*d*) the polarizing coils, parallel connected, (*e*) the Morse printing coils, (*f*) the alarm bell, parallel to the magnet. The heavy current battery consists of four dry cells having an approximate e. m. f. of 6 volts. The current from the battery is carried through the two contacts on the resistance box of the receiving apparatus, the working contact of the relay, the tapper coils, through a second plug contact and thence returning to the battery. The polarizing coils are connected in the heavy current circuit until the relay tongue is in contact with the stationary contact. The battery current ceases when the polarized coils are sufficiently magnetized and have, therefore, an opposing e. m. f.. For this reason the battery is not weakened by a current of long duration.

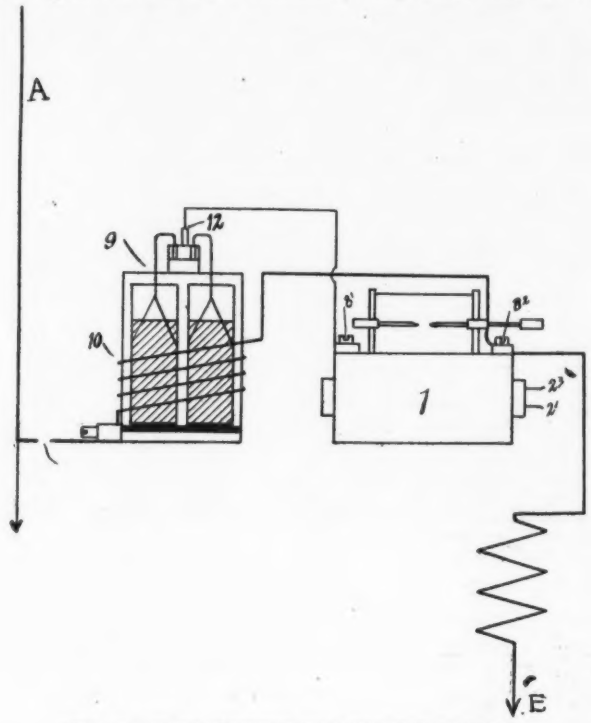



FIG. 3.—HIGH-TENSION TRANSMITTER CIRCUIT.

When the relay tongue makes contact the current is carried through the wiring of the tapper, the resistance of which is 6 ohms, and the polarizing coils, now short circuited, permit the tongue to assume its normal position. If the contact made by the tongue is broken the polarizing coils take up the energy originating from self-induction of the tapper coils and the Morse magnets preventing the spark arising from breaking the circuit and the attendant untoward effect on the coherer.

The Morse printing apparatus is connected parallel to the tapper. It has four binding posts connected in parallel in couples. One of these couples may be disconnected by a switch. The two posts permanently connected with the circuit operate the printing apparatus, and the other two posts are connected to an alarm bell, which serves to notify the operator when at a distance from the receiver.

In the second Slaby-Arco type of apparatus the instruments are much less complicated, and a self-restoring coherer made of aluminum and steel takes the place of the standard silver coherer, described in the preceding type. The Morse printer is supplanted

by a telephone receiver, the coil is of the portable type and the antennæ are suspended by means of kites and balloons. It is designed for portable work such as army and field use.

The third type is made expressly for use on war vessels. The transmitter, tuning inductances and capacities are arranged somewhat differently from the standard apparatus where the wiring is not difficult. For instance, it is hardly possible to have instruments on boats beneath the armored deck, because the carrying of high-potential wires is exceedingly dangerous. This is overcome by having the apparatus in a room beneath the deck and a spark-gap and multiplying coil mounted on the deck in a water-proof compartment. This is connected with the apparatus by a wire carried through the passage and hatchways to the coil.

## Aspen Tunnel and Power House.

AMONG the many improvements on the Wyoming division of the Union Pacific that have been instituted under the regime of President Burt at a cost of over $10,000,000, the cut-off from Leroy to Bear River to avoid the celebrated Tapioca Hill is probably the most important. This includes the Aspen Tunnel, 5900 ft. in length, which is considered by engineers a masterful piece of work.

Owing to the character of the material encountered, the pressure of water and gas and flow of oil, the construction of the tunnel presents some features of particular interest to engineers. The formation is the carboniferous in which are found soft shells and sandstone.

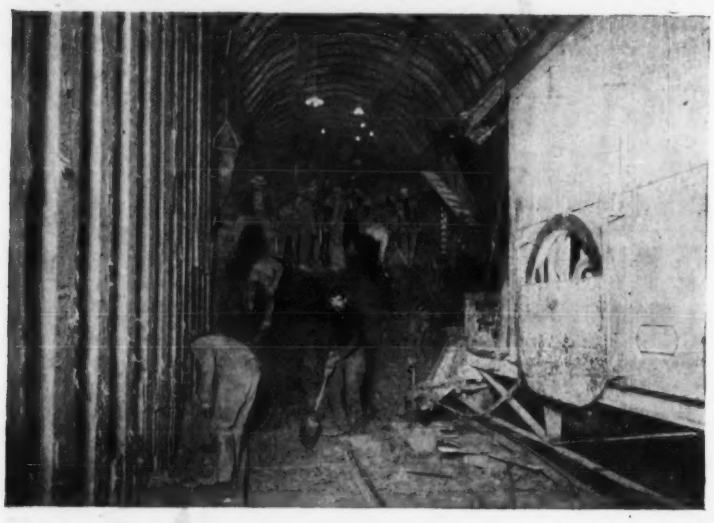


FIG. I.—INTERIOR OF TUNNEL.

With every little stream that trickled through the layers of shale the danger developed. Work was at one time stopped on account of an inflow of oil, water and shifting sand, which completely closed the tunnel. The question of a sufficient lining to the tunnel was thoroughly debated. Finally, it was thought that plumb timbers of Oregon pine, 12 by 10 inches, with steel "I" beams 16 by 16 by 6 would stop the swelling ground. Upon erection, however, it was soon made evident that this construction did not afford sufficient strength. Finally, 96-lb. rails were laid crosswise to a depth of 10 ft., and covered with a thick layer of Portland cement, thus making the tunnel to-day as safe as the surrounding hills.

Electricity has been used throughout as a lighting agent in the camp and workings, over 300 lights being used. A 60-kw Westinghouse alternator is driven by a 100-hp Westinghouse engine from a bank of four 100-hp boilers, which also supplies three large compressors and other machinery for repair work. The power house is 3000 ft. from the east portal, making the distance about 9000 ft. through which to transmit current. The current was transmitted at 1100 volts and transformed through transformers at each portal, 208 or 104 volts.

It was found necessary to have two separate circuits on account of the divided workings, as the "headings" were driven some distance in advance of the "bench" into the "head workings," the third wire was kept back of the "bench" so as to have a separate source of light, made necessary by the continual blasting. In the finished part of the tunnel the lights were alternated on either side 25 ft. apart, so that if short circuit occurred in either working, half of the lamps were left in circuit.

The transformers were fused considerably higher than necessary, so as to hold a short circuit for about one minute. A No. 8 waterproof cable was used in the tunnel and No. 6 wire from the power house to the east portal. A No. 8 bare copper line ran over the mountain to supply the west portal and camp. For the lamps No. 16 vulcanized lamp cord was used with four light clusters, the flexible lead enabling the lamp to be carried back out of the way from the blasts.

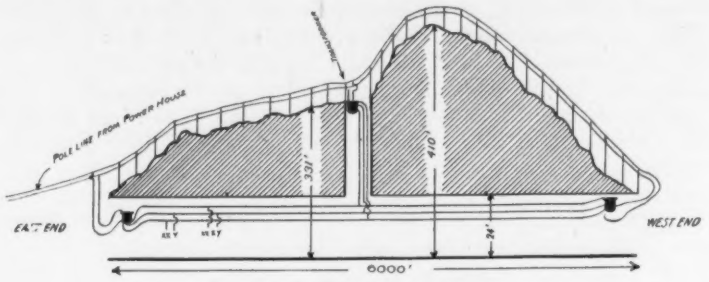



FIG. 2.—SECTION OF TUNNEL.

All shots were set off with electric current, electric exploders being used.

Incandescent lamps of 16 cp were used throughout the workings, as they gave better service than arc lamps, and were easier to handle and moved about. All mucking was done by steam shovels, which were lighted by six-lamp clusters in reflectors, moved along with the work. The entire plant was installed and is still in charge of Mr. T. E. Daniels, of Provo, Utah.

## The National Telephone Company's New Exchange at Kensington, London.

An article appearing elsewhere in this issue deals very fully and interestingly with the telephone situation in London, and it will have been noted that mention is made therein of the new exchange which the British Post Office Department is building for the metropolis, in Queen Victoria Street. Meantime, the National Telephone Company has been "putting its house in order," and has just opened its new exchange at Kensington, the first in London, and also one of the very few in England, to operate on the common battery, lamp signal sys-

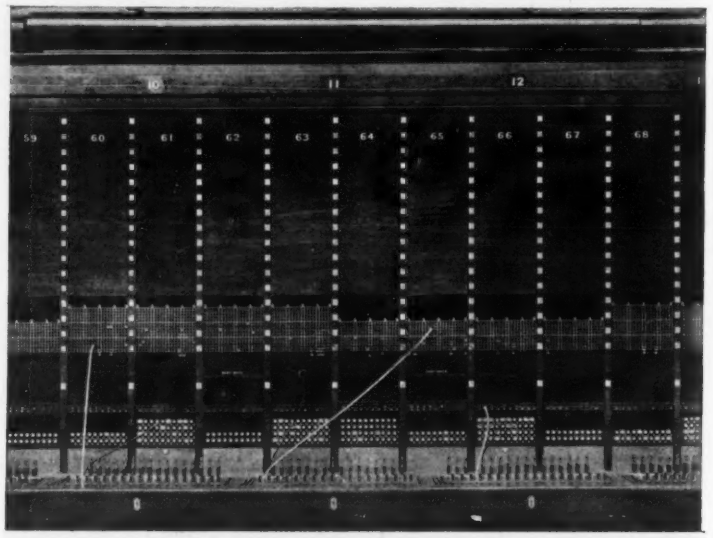



FIG. I.—ONE SECTION OF SWITCHBOARD.

tem. It will have been noted that the new government exchange is also of this modern kind, a fortunate and perhaps inevitable result of the intention to exchange business, while the further fact that they are of Western Electric Company's construction tends to ensure that smooth co-operation and uniformity of apparatus, without which the exchange of telephone calls between competitive networks is attended by no small amount of difficulty and with a serious diminution of efficiency and satisfaction.

To our American readers, and, indeed ,to all who are in the habit of reading this journal in any part of the world, there is not much

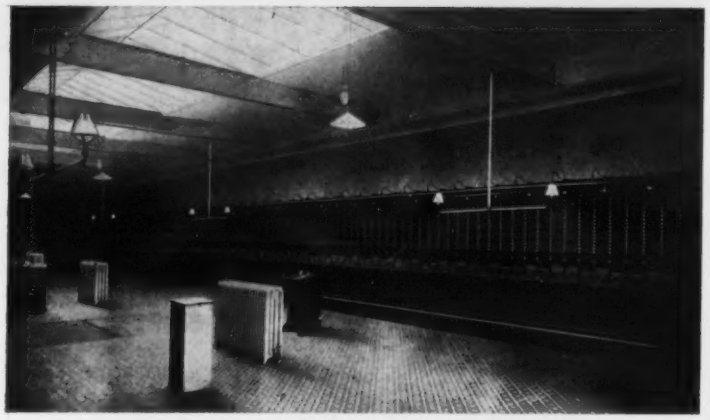


FIG. 2.—GENERAL VIEW OF SWITCHBOARD ROOM.

now that is new in a common battery lamp signal exchange, and we need not add much to our engravings by way of description. At the

FIG. 3.—POWER ROOM.

present time, the exchange is equipped for 2000 subscribers' lines, and the ultimate capacity of the board is 12,000. Each section of the board has three operators' positions. At present there are only 60

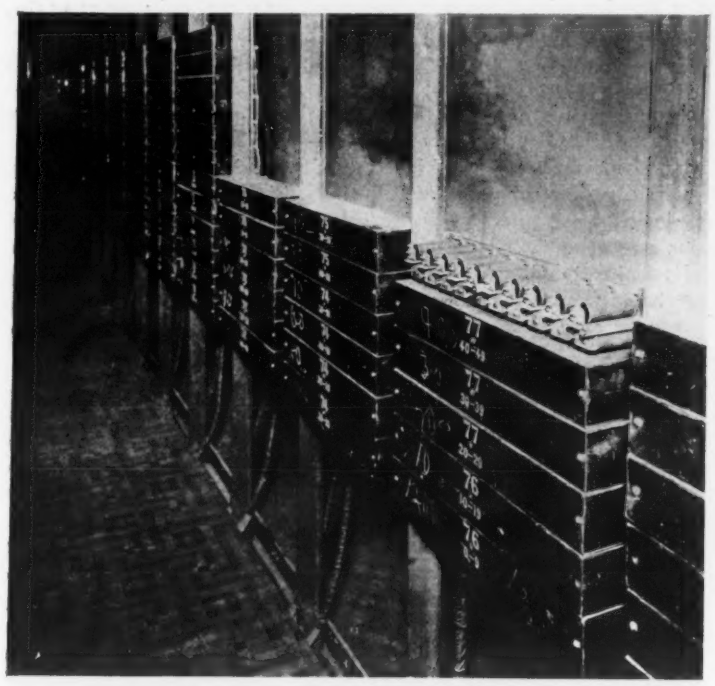


FIG. 4.—RELAY BOARD.

subscribers per operator's position, but it is the intention to increase the number soon to 80, while when the message rate basis goes fairly into operation it is calculated that the lessening of work per line may enable an operator to handle 200 stations. At Bristol, England, the allotment is 120 subscribers to each position.

The switchboard includes 5305 relays, 1300 resistance coils, 600 condensers, 640 miles of wire and 4,500,000 joints or soldered connections. The subscriber's set includes the usual apparatus, the bell having a resistance of 1000 ohms, and the primary and secondary of the induction coil 1 and 25 ohms, respectively. The relays at the ex-

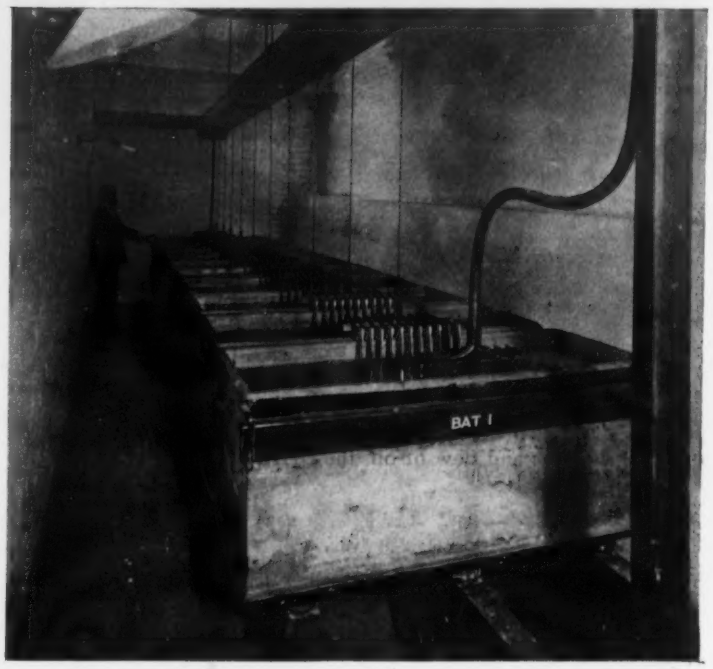



FIG. 5.—BATTERY ROOM.

change are situated in the basement below the switchboard room, together with the test board, the distributing board and the power plant. A view is shown of the power plant, situated in the basement. Two 15-hp Fuller-Wenstrom motors receive single-phase current at 100 volts from the mains of the Brompton & Kensington Company, and are belted to shunt-wound dynamos, each furnishing a maximum current of 330 amperes at 28 volts. The chief feature

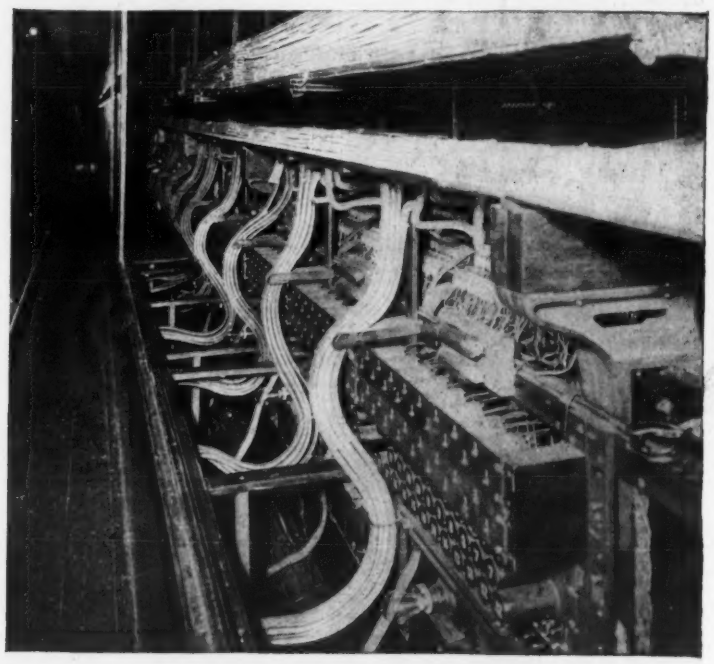


FIG. 6.—REAR OF SWITCHBOARD.

about the dynamos is the large number of segments to the commutators to avoid the possibility of induction disturbances in the circuits. There are two batteries, each of 11 cells. The charging e. m. f. is regulated by the shunt coils of the dynamo, and no regulating cells are employed. The present capacity of the cells is 2000 ampere-hours, and the ultimate capacity, when full of plates, will be 6000 ampere-

hours. The batteries are of the chloride type, and the Western Electric Company supplied the whole of the power plant, with the exception of the motors. Two small motor-generators, each of about ½ hp, take current from the cells and furnish alternating current at 75 volts and at a suitable frequency for ringing. The general planning of the work, the wiring of the switchboard, etc., has, of course, been carried out by the National Company's own engineering staff, which has introduced detail features of change and improvement adapted to London conditions and requirements.

The National Telephone Company's London system, which includes this new exchange, extends from Waltham Cross in the north to Redhill in the south. In the east it includes Tilbury, and in the west Harrow and Ealing, the whole covering 640 square miles. In this there are 50 exchanges, employing 910 operators and serving 44,700 subscribers' instruments (including 890 call offices). The junction lines between the exchanges have a total mileage of 18,190, their number being 2513.

## The London Telephone Situation.

THE telephone question in London has been a lively subject of discussion during the past few weeks. The discussion culminated in a debate in the House of Commons, of which it was actually predicted by some of the London "yellow" journals that a Government defeat might result, the dissatisfaction over the famous telephone agreement between the Post Office and the National Telephone Company having been expected to crystallize into the voting of an amendment to the address in response to the King's speech. As a matter of fact nothing of the kind happened. On hearing, not by any means for the first time, however, the Post Office side of the case, the mover of the amendment—no less a person than the Lord Mayor of London—begged for leave to withdraw the amendment, which was refused; instead it was voted down by a comfortable Government majority of 88 in a rather thin house. Consequently, the agreement between the Post Office and the National Telephone Company governing the combined London telephone system stands, at least until 1905, when an opportunity occurs under the terms of the agreement for a revision of its conditions.

This brief recapitulation of recent events is putting the climax before the history of the case, which is a rather complicated matter, somewhat difficult to set forth clearly in a few words. There has long existed more or less discontent in London with the rates and methods of the National Telephone Company, and this discontent has been actively fostered by all sorts of irresponsible busybodies, County Council cranks, yellow journals and people with axes of their own to grind. Resulting from this agitation, there was held a Parliamentary inquiry into the telephone question in the summer of 1898. This committee had as its chairman Mr. Hanbury, a Treasury official, and its proceedings and report were in a spirit distinctly hostile both to the National Telephone Company and to the permanent officials of the Post Office, who had a short time before concluded an agreement with the National taking over the whole long-distance plant and business of Great Britain, previously operated by the company. The committee report advocated the fostering of competition against the National Telephone Company, both by the granting of telephone licenses to the municipalities and by the establishment of a post office exchange in London. Glasgow had long been agitating for a telephone license, and has since obtained it and has started its system. The example of Glasgow has been followed by several other large towns, and the National Company is now meeting competition from municipal exchanges in several places, and is threatened with it in a number of others.

As regards the Post Office London system, Parliament approved the recommendations of the 1898 committee report and voted a credit of two million sterling for the purpose of enabling the Post Office to provide London with an up-to-date and comprehensive system with which to fight the National Telephone Company. The Post Office proceeded in a thorough and systematic manner. Two of its most capable engineers made a thorough study of telephone conditions in the United States, traversing the country from Atlantic to Pacific, and reported at length on the progress and trend of American telephone engineering and practice. Then they went home and proceeded to lay out a telephone system in London on American lines. The Post Office Savings Bank staff was moved out to the country, and the Savings Bank Building, in Queen Victoria Street, in the heart of the city, was converted into a telephone building and equipped with an American common battery plant, constructed and installed by the Western Electric Company, of an ultimate capacity of some 9000 lines. This is to be the main "city" or downtown exchange, about corresponding to the Cortlandt Street exchange in New York, and is now nearly completed. Numerous other exchanges of a similar type are planned and in course of construction.

In London every electrical company builds its own distribution system in its own way, there being no subway or conduit system for general use, with the exception of the County Council subways or tunnels under the newer streets and avenues. These are few and far between, and are not available for a comprehensive system of underground cable distribution, while the existing Post Office underground telegraph lines consist of gutta-percha-covered wires, laid in iron pipes under the sidewalks, this system offering no facilities whatever for the accommodation of telephone cables. Consequently, for a good part of two years the Post Office engineers have made the lives of Londoners miserable by tearing up the main streets in all directions for the construction of an extensive system of iron pipe telephone conduits. Complaints were both loud and deep regarding the hopeless condition that this work threw the narrow London streets into, but the Post Office pursued the even tenor of its way, built its conduits as thoroughly, as slowly and as extensively as it had planned to, and the Londoners had to make the best of a bad job and content themselves with anticipations of a new and highly efficient Post Office telephone service at cheap rates that would bring the service within the reach of all and sundry.

Many prognostications as to the rates that would be charged by the Post Office appeared from time to time in the papers. Sir William Preece, before the 1898 telephone committee, had advocated a divided rate of £4 a year maintenance charge, with a message rate of 1 penny a local message—say, $20 a year plus 2 cents a message—and the general idea seems to have been that this style of rate would be adopted, with even a lower maintenance charge and perhaps a lower message charge, some prophecies going as low as $12.50 a year maintenance charge and 1 cent a message. Others believed that a low flat rate would be offered, at some figure that would about cut the National Company's charges in two. A flat rate at this figure (say, $50 a year) has long been advocated by the London County Council, which body for years past has taken a stepmotherly interest in the telephone service, and by its obstructive tactics and intensely ignorant and prejudiced criticism has done much to embitter the discussion and to manufacture difficulties for all concerned.

In one way and another the impression was created on all sides that the Post Office was about to embark in an active competition with the National Telephone Company for the telephonic business of London, starting with a new and comprehensive plant, and with rates that would enable the butcher, the baker, the candlestick maker, and, presumably, that sacred London institution, the chimney sweep, to become telephone subscribers. The unpractical features of such a scheme, considering that the National Company has about 40,000 stations in London and the Post Office none at all, and the wastefulness of it, in view of the high cost of work in London and the impossibility of conducting such a competition, and at the same time paying expenses, never seem to have struck anybody. The impression was general, sedulously fostered by the yellow press, that a sort of telephonic millenium was about to dawn in London. We did our best to combat such erroneous views at the time.

Judge, then, of the cry of mingled rage and horror that went up a couple of months ago when the announcement was made that the Postmaster General had executed an agreement with the National Telephone Co. under which the two systems are to charge the same rates and to exchange traffic. This agreement and the tariff adopted for both systems put an end to all talk of real competition, and also extinguished all hopes of the bargain-counter rates that the Post Office had been expected to establish.

The tariff provides for both message rate and unlimited service, abolishes the distinction between residence and business service and establishes two districts in the immense area of London, the County of London forming one district, and the area outside forming the second. Messages passing from one district to another pay double the charge of messages local to the inner district or to a single exchange in the outer district. The message rates are all on the divided plan. In the County of London the rate is $25 a year plus 2 cents each for messages local to the county and 4 cents each for messages to stations outside the county; outside the county the maintenance charge is $20 a year with 2 cents each for messages local to the

same exchange and 4 cents each for messages to any other exchange. In each case the minimum yearly payment for messages is $7.20, making the minimum rate $32.20 and $27.20, respectively, for a *maximum* of 360 local messages a year, if all the messages used are at 2 cents each. For two-party line service the maintenance charge is reduced to $15 a year, and for ten-party line service (available only in the outer district) to $10 a year, but the minimum yearly charge for messages in each case is $15, making the minimum rates $30 and $25, respectively, for a possible maximum of 720 local messages. A party-line subscriber, therefore, pays only $2.20 less a year than a direct-line subscriber( both at the minimum rates), but gets 360 more 2-cent messages (or 180 4-cent) for his money, which seems rather an anomalous arrangement. The flat rate is $85 a year for the first line and $70 a year for each additional line taken by the same subscriber. The pay station rate for a local message is reduced from 6 cents to 4 cents. The great change made by this tariff is the introduction of the message rate principle with a minimum rate of less than half the lowest figure at which telephone service has hitherto been supplied in London on an original subscription. For this great step in advance the Post Office is entitled to great credit, and will almost certainly reap its reward in causing an immense development of the telephone in London. Alongside this radical step, the other changes in the National Company's rates are of comparatively slight importance. The flat rate was formerly $100 for business and $60 for residence service, with a discount of 15 per cent on a five-year contract. Under the new tariff the five-year rate, $85 for business service, is applied to yearly contracts and the residence rates are abolished. Residence subscribers will, of course, be expected to take message rate contracts.

This tariff and the agreement to exchange traffic between the two systems, which, of course, precludes the idea of active competition, did not at all meet the views of the County Council and other local authorities, and a vigorous outcry was made in the press, the more hysterical journals indulging in columns of blatant nonsense on what they were pleased to term "The Telephone Betrayal." The agitation was ignorant, prejudiced and wholly unguided by any intelligent grasp of the question. It has utterly failed to upset the agreement, and it deserved to fail. The County Council, advised by a consulting engineer who has no acquaintance whatever with practical telephony, had set its heart on controlling the London telephone system and on establishing a $50 flat rate, and as the County Council has apparently an ability for making noise in inverse ratio to its other abilities most of the agitation originated with that body and was fomented by it.

Deputations waited on the Postmaster General. A conference of local authorities was held at the Guild Hall, which sent incoherent resolutions to the Postmaster General, to the Prime Minister and to various other officials. The agitation culminated in the debate in the House when the Lord Mayor found he had gone off at half-cock, so to speak, and felt forced to abstain from voting for *his own* amendment after trying to withdraw it! The reply of the Post Office to this outpouring of inexpert criticism may be summarized in a few words, though it has several times been stated in many. Real competition with the National had never been contemplated by the Post Office, as it was impracticable. A system with no subscribers could not compete with a system of 40,000, without intercommunication between the two networks, which, of course, would have been denied. Then, in active competition, the Post Office would have been obliged to withdraw the way leaves it now grants the National, and the London system would have been thrown into chaos. Further, a cut-throat competition in rates, in other words, a losing business, would have been unfair to the taxpayer, whose money supplies the capital for the Post Office system. On the other hand, the Post Office is in course of establishing a thoroughly comprehensive system in London equipped with the most modern appliances, and will furnish a service first class in every respect, competing with the National Company in efficiency and variety of facilities offered to the telephone user. It has introduced the message rate system and has caused the National Company to do likewise and also to modify its tariff in other respects. In so doing, it has brought the London telephone service within reach of the masses for the first time. The tariff and the working arrangements laid down in the agreement were arrived at as the result of an expert study of the situation and the Post Office rightly refused to budge an inch from the position it had arrived at after several years of investigation, estimate and negotiation.

This defence, put forward by the Postmaster General and by the Treasury, has very properly prevailed. The tariff and the agreement stand, and will have at least three years working trial. The tariff is open to criticism from an American point of view, but this historical article is concerned merely with a record of a highly interesting telephone controversy in what is undoubtedly the most tempting telephone territory in the world—the city of London, with its magnificent distances, its business and social activity, and its teeming millions inclosing hundreds of thousands of possible telephone users. It must be admitted that the technical and permanent staff of the Post Office have made the best of a bad job. Telephone competition was forced on them by Mr. Hanbury's committee, and all must admit that competition to be carried on with public money against the public licensee (mulcted 10 per cent of its gross receipts for the mere right to do business) was an act of questionable morality. It is unquestionable that in 1898 Mr. Hanbury meant real competition, the object being to hamper and restrict the National Telephone Company and to depreciate its securities against the time when the Government will have to buy up the whole business. When the Post Office experts got to work on the question they naturally determined that real competition was impracticable unless the two millions of public money were to be thrown into the gutter; and they further found that the National Company's principal rate was so far from being unreasonable and extortionate that they adopted it themselves, although it means 10 per cent more to them than to the company, since the Post Office has to pay itself no royalty. The present plans of the Post Office should result in an improvement of London's telephone service, and in its rapid development. The adoption of message rates will be a real boon to the London public, as is proved by Mr. Chamberlain's statement that the Post Office canvassers were taking a dozen message-rate contracts to one flat rate. In fact, Mr. Chamberlain thinks that the flat rate should be abolished altogether.

While, however, the partnership between the Post Office and the National Company, for that is what the arrangement really amounts to, should result in improving and developing the London telephone service, the whole controversy furnishes a striking illustration of the disadvantages of Government control of telegraphs and telephones. Had the National Telephone Company been allowed to put its wires underground and to develop London telephonically without continually meeting the obstructions and restrictions imposed by every authority, from Parliament down to the meanest vestry that rules a few miles of streets, the ultimate result would have been better and cheaper for all concerned.

## An English Banker on American Competition.

The chairman of the London & County Banking Company, at the recent annual meeting of the shareholders, had this to say of the commercial situation and the "American invasion": "If in Asia and Africa we have had to withstand the attack in arms of our enemies, we have had also to withstand, on the other hand, the almost too impetuous advances of our cousins in America. They desire to be in such close relations with the mother country that, with their many-million-dollar power, they desire to possess, in order to show us how to utilize them better than we have done, our mercantile marine, our suburban railways, and much of our manufacturing enterprise.

"Well, let us welcome them, and if they have useful lessons to teach, let us learn them. We need not sell our ships or our enterprises, except on satisfactory terms, and the result of the first stage is that Englishmen find many American dollars, or their equivalent, safely in their pockets, and I do not think they will long lie idle there. The world is big enough for us both—big enough for far more friendly competition, even between England and America, than there has ever been yet—and I welcome the thought that the two great Anglo-Saxon races will go hand in hand to civilize the dark places of the world, even faster than it was thought possible a very short time ago."

## Tower for St. Louis Fair.

A giant tower is one of the special features proposed unofficially for the St. Louis Fair, to cost $1,500,000, consisting chiefly of a globe 350 ft. in diameter, carried on pillars 250 ft. high, with an observation tower 100 ft. above the top of the globe. It is to be built of steel and bristle with electric lights. The Eiffel Tower has disfigured two Paris expositions, and it is to be hoped St. Louis may escape this hideous infliction.

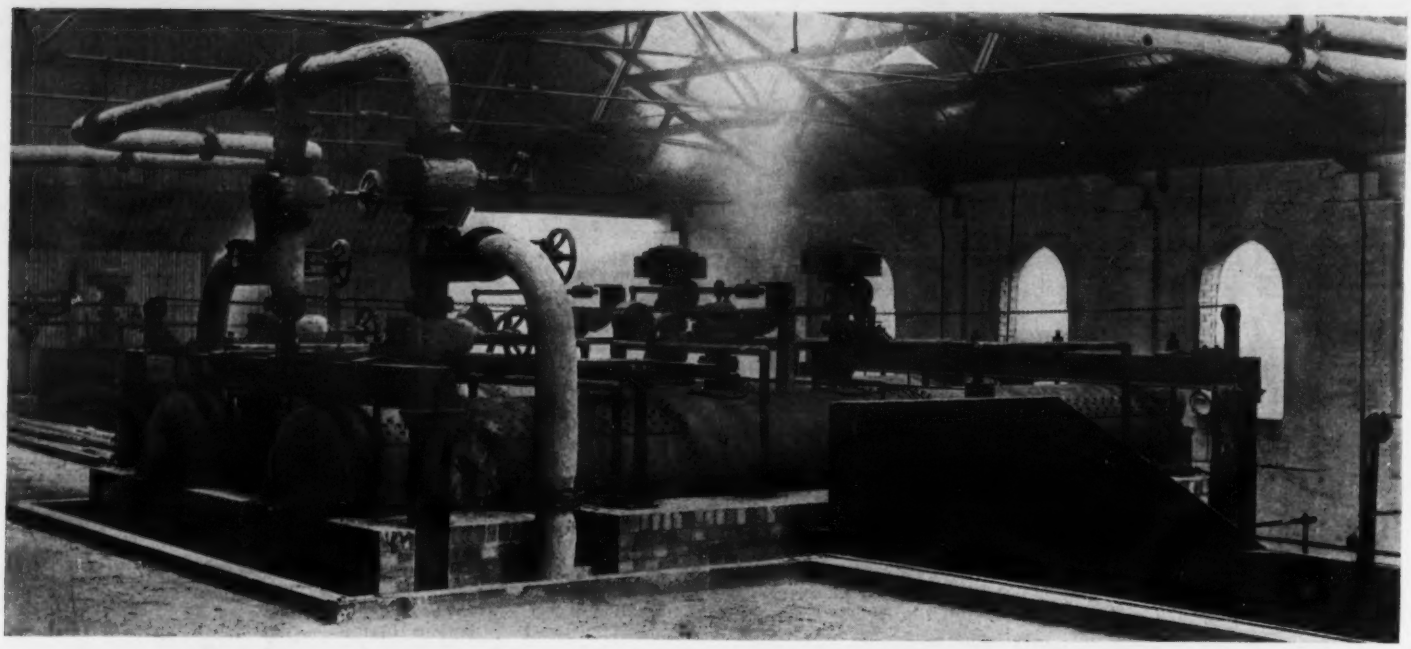


FIG. 1.—STEAM PIPING, BOILER ROOM, BERMONDSEY PLANT.

## Two Recent English Central Stations.

ONE of the most interesting of the recent central station plants started in England is that of the borough of Bermondsey, a populous district of London. Its main feature of unfamiliarity to Americans is its use of street refuse, a practice which somehow has made no headway in this country, and which, so far as we can judge, has not altogether proved its case to the satisfaction of European engineers. The plant at Bermondsey is close to the Town Hall, and comprises destructor house, pump house, engine room, battery room, etc. The destructor is at present made up of six cells, arranged to the design of Mr. A. J. Liversidge, for a maximum consumption of 50 tons of domestic and trade refuse daily. The rubbish is brought by carts up an inclined roadway to the tipping platform, where it is shot into the receiving hoppers, from which it is pushed through traps on to the drying hearth. The principle moisture is here driven off by heat, and the refuse can then be raked, from the firing doors, on to the grate bars, where it is burned in the usual manner. Each cell has a grate area of 25 sq. ft. The heat from the refuse passes through flues to the water-tube boilers, thence through duplicate flues to the stack. Forced draught is applied to the furnaces, and the pressure, regulated from the firing door, is created by three fans, two driven by steam engines through spur gearing, and one by an electric motor directly coupled to the fan. A stand-by to this draught is provided in steam jets fitted to all the furnaces.

The boilers, three in number, are arranged for firing with coal if necessary, and they have a grate area of 39 sq. ft., a heating surface of 2010 sq. ft., and an evaporative capacity of 6000 lbs. of water per hour. The boiler furnaces are also provided with both the fan and steam draught pressures. High and low water alarms and Dowrance fittings are mounted on the boilers. The steam pressure is 150 lbs. per square inch. Boiler feed is obtained from duplicate pumps, delivering through a twin set of piping to the boilers either direct or by way of a Green economizer of 240 tubes at the base of the stack. The economizer scrapers are motor-driven. At present the feed water is taken from the town mains, through a water softener, to a tank holding 10,000 gallons. The delivery to the softener is controlled by a ball valve acted upon by the water in the tank, the same delivery driving a water motor on the softener for mixing the chemicals with the water to be dealt with. The apparatus will soften 2000 gallons of water per hour. An artesian well is being bored for the supply of water, not only to the works, but to the adjoining public baths also, and it will provide 6000 gallons per hour. A motor is to be fitted for the operation of a single-throw pump to deliver the water either to the softener or the baths. It is interesting to note that the surplus steam, of which there is expected to be a quantity, is to be utilized in one instance for heating the feed water, and in the other for driving the draught fans, two of which are steam propelled. The stack is 150 ft. high, and it has been erected by the contractors for the destructor plant.

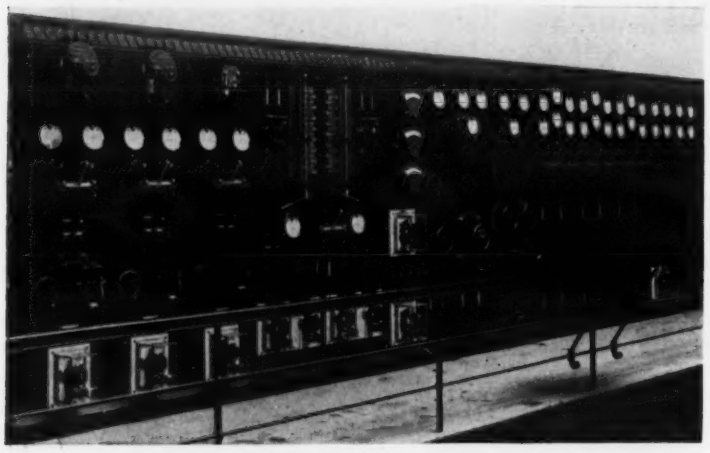


FIG. 2.—SWITCHBOARD, BERMONDSEY PLANT.

FIG. 3.—BOILER ROOM, BERMONDSEY.

The engine room contains three generating sets, one of 75 kw and two of 150 kw output, comprising Willans engines directly coupled to dynamos made by the Thames Ironworks Company. The engines are Willans two-crank and three-crank types, respectively, the small set of 100 hp running at 450 revolutions, and the large sets of 220 hp at 285 r. p. m. At present the engines run non-condensing and exhaust into the chimney. The dynamos are shunt wound, as there is no likelihood of power being required for street cars at present, but should this arise the extension plant will be supplied compound wound. Current is generated at 480 volts, and is distributed on the

three-wire system, equalizing being effected by balancers and battery in the usual manner.

The switchboard, mounted on a platform above the engine room floor, is made up of controlling arrangements for three dynamos, six feeders, eight arc circuits, battery, balancers and and boosters. Wattmeters are fitted on the dynamo panels and also in the bus-bars between machines and feeders, so that the generating units can be balanced against those registered by the feeder wattmeters. The dynamo main switch is interlocked with the field-breaking switch, and reverse current cut outs are fixed to these panels also. The feeders are supplied with duplicate fuses, and compensating voltmeters for measuring the volts at the feeding point are included in the fittings. The arc circuits are controlled from the board, 10 arcs being run in series across the outers of the system, while resistances are inserted for the regulation of the potential to the lines. The balancer and booster panels are fitted in the usual manner, and the battery regulating arrangements are also of the ordinary type. Wattmeters are inserted in the charge and discharge circuits of the cells, as it was thought that separate instruments were more accurate than the reversing pattern. A useful adjunct to the board is found in a switch which, should breakdowns to the generating plant occur, can be closed to put the battery on to the Town Hall circuit, thus maintaining the supply to that important building. A panel fitted with recording ammeter and circuit breaker in the earth circuit completes the switching arrangements.

The balancers, placed under the switch gallery, are capable of

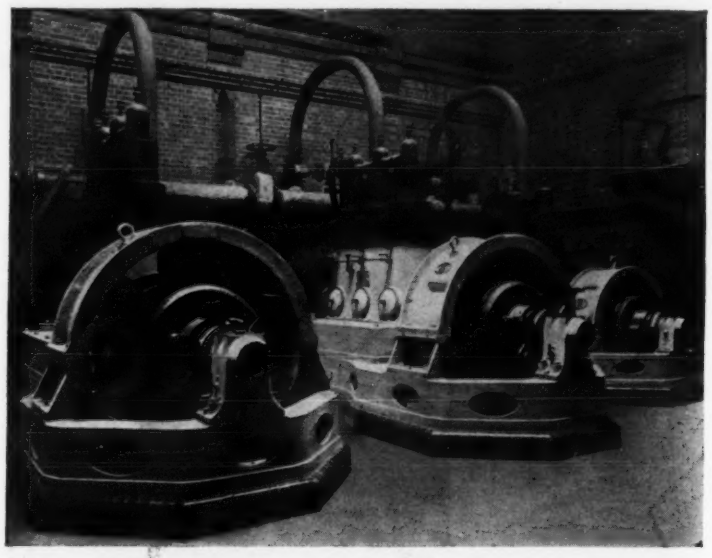


FIG. 3.—GENERATING PLANT, BERMONDSEY.

dealing with an out-of-balance current of 50 amperes, their armatures revolving in separate fields on a common bedplate. The boosters, fixed near the balancers, are each driven by a common motor placed in the center of the bedplate, and the pressure in the battery circuit when charging or discharging can be raised from 10 to 100 volts. A hand-power crane, capable of lifting 10 tons, runs the entire length of the engine room, and a temporary end is at present erected to the building to allow for future extensions.

The storage battery cells of the Tudor Company's make are mounted in a room behind the switchboard, in two tiers, the positive battery forming the upper and the negative battery the lower tier. A maximum discharge of 300 amperes for one hour can be obtained from the battery without injury, the charging current of 100 amperes being maintained for 5¾ hours.

The mains of Glover make are laid solid in the case of distributors, and drawn into Doulton conduits in the case of feeders and arc circuits. A tile trough is employed with the distributors, which are laid with a view to sectionizing in case of fault.

Feeder pillars are fixed above the pavement level at suitable points in the network, and they provide for the fusing of both the feeder cables and the distributors. The boxes are so arranged that a demand indicator can be inserted in the feeder circuit at the point in question, and the maximum load at that spot can be recorded without difficulty. The feeders are triple-concentric cables of 0.25 square inch section, lead-covered, paper-insulated, the distributors of similar pattern, but of 0.10 square inch section, and the arc light lines of twin conductor, 0.023 square inch section. The connections throughout the entire distributing system are sweated in every case.

The 70 arc lamps are of Crompton double carbon pattern, burning 32 hours. Two incandescents, of 16 cp each, occupy the lower part of the arc posts, and these are automatically operated by an Edmunds switch in the base of the column. The design of the posts received the first prize at the Edinburgh School of Art.

The bye-products of the destructor plant are to be utilized for making flagstones, and the machinery used is electrically driven. The

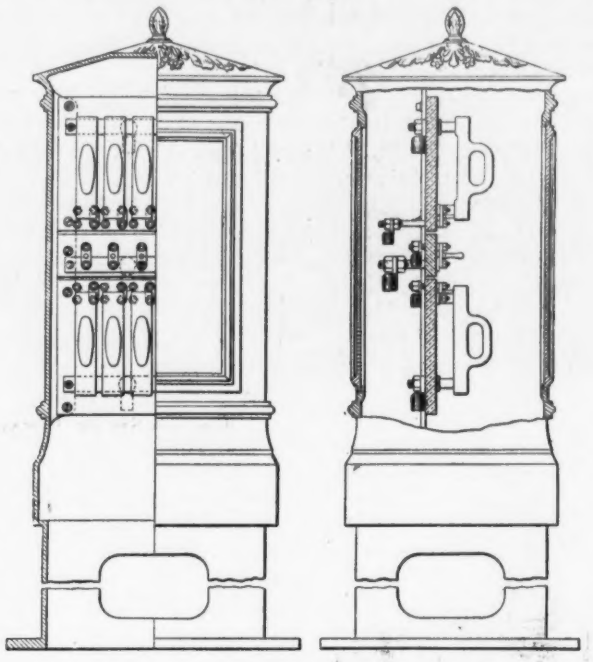


FIG. 4.—FEEDER PILLAR, BERMONDSEY.

clinker is ground in a mill and mixed with water into a paste, which is hydraulically pressed into a die the size of the flag required. A 25-hp motor will drive a countershaft from which the grinder, mixer and hydraulic pump will be driven.

Chamberlain and Hookham meters are used, and the Wright system of charging has been adopted for lighting, the rates being 12 cents for first hour, 6 cents all time after; for power, a flat rate of 5 cents per unit will be put in force, and a preferential charge of 6 cents per unit is to be made to churches. Mr. W. H. Vincent is the

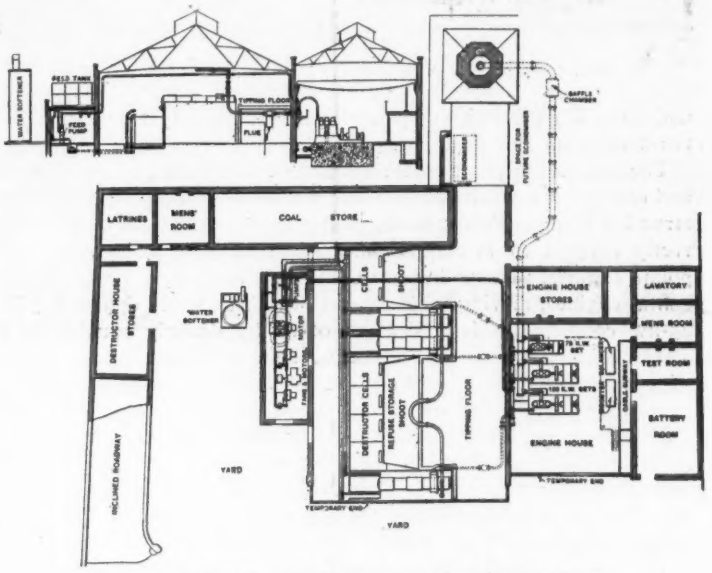



FIG. 5.—SECTION AND PLAN, BERMONDSEY STATION.

borough electrical engineer, and Messrs. Kincaid, Waller and Manville were the consulting engineers.

The other recent plant is that of the Crystal Palace District Electricity Supply Works, at Sydenham, and is one that will doubtless be visited by a good many Americans this year during the continuance of the American Exposition within the glass walls of the world-famous Paxton palace. The station which will furnish much of the current for running American apparatus on view does not, however,

present any particular feature of great interest, and may be taken as a good example of current English distribution practice on medium-sized stations. The original plant was put out of commission by a disastrous boiler explosion in July, 1900. The present works consist of an engine room measuring 79 ft. by 32 ft. 6 inches, and a boiler house running parallel to it which is 57 ft. long and 30 ft. wide. The building is covered by an iron-stayed roof and a skylight surmounted by louvres runs the full length. The chimney shaft has been lengthened 20 ft., thus making the present height 110 ft., the internal measurement being 6 ft. square. The pump and heater rooms are situated alongside the shaft, and in a separate building are the transformer and battery rooms, also large stores, fitters' and carpenters' shops, meter rooms and offices.

Three Hornsby double water tube boilers, each of 276 hp, have so far been erected, each boiler having two steam drums of 4 ft. diameter by 26 ft. long. Vertical tubes lead from either end of the drums, those from the front being connected into headers, which each contain a set of 72 four-inch tubes, and, at the back lead into a common mud-drum, which is connected by a number of horizontal tubes to the headers. A cast-iron breeches pipe connects the steam drums. All the boiler fittings are by Messrs. Hopkinson, and consist of the usual complement, including high-pressure and low-water alarms. The boilers are fed from the pumps through 2½-inch valves fixed on each steam drum, and in addition a Buffalo injector is fitted at the front for emergency purposes. An extra blow-off with internal pipe is fitted to each steam drum to prevent accumulation of mud. The very best Welsh coal is at present burned to avoid smoke nuisance, as private houses are situated on the adjoining hill level with the top of the shaft. Feed water is passed through Berryman exhaust heaters,

FIG. 6.—SECTION AND PLAN, CRYSTAL PALACE STATION.

and three Worthington pumps are installed, each capable of supplying two boilers on full load.

The generating plant comprises three 210-kw sets, two 90-kw sets and one 45-kw set. The 210-kw sets consist of two-pole Electric Construction Company's dynamos, giving 1050 volts at 420 r. p. m., directly coupled to Messrs. Belliss' standard type three-crank compound engines. The 90-kw sets are the old Hornsby slow-speed horizontal engines, driving with ropes E. C. C. two-pole dynamos. The 45-kw combination is a Willans of 80 hp directly coupled to an E. C. C. machine. The foundation has been laid ready for the erection of another 210-kw generating set. A 15-inch exhaust main runs nearly the entire length of the engine room below the floor, and after passing through the heaters is taken up the chimney shaft to within 30 ft. of the top. This pipe was not reduced in size in the engine room, with a view to allow of the installation of a condenser at the far end. A 5-ton traveling crane traverses the engine room at a height of 15 ft.

Five feet above the engine room floor the switchboard is mounted on a gallery, which is constructed of steel joists resting on 14-inch wall with a facing of white glazed bricks. The floor in front of the switchboard overhangs, and is filled in solid with concrete, which is paved with glass as a safeguard against shocks; rubber mats are also used for further protection. The panels of the board are designed in standard widths of 1 ft. 6 inch and 2 ft. The generating panels each consist of one double-pole chopper switch, interlocked with a field-breaking switch, one pair of single-pole enclosed fuses, and main and exicting ammeters. The distributing panels have voltmeter and pilot plugs, circuit ammeter, double-pole chopper switch, transformer starting and regulating switches, and one pair of single-pole enclosed fuses. The live parts of the switches are protected with plate glass shields.

There are six generating and 10 distributing panels, and a blank slate is fixed on the top of each panel to provide space for wattmeters, which would be connected with generator and sub-station circuits. A copper bus-bar, designed to carry 1500 amperes, runs the full length of the board, and is supported on porcelain insulators.

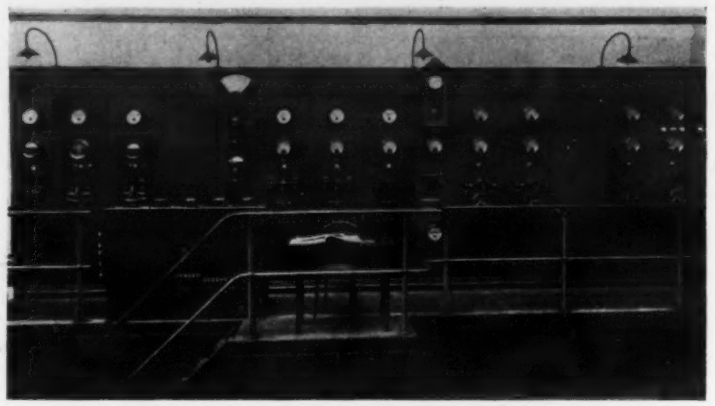


FIG. 7.—SWITCHBOARD, CRYSTAL PALACE STATION.

An ammeter is inserted in this bar, between the generating and distributing sections. There is also a low-tension bus-bar from which the generators are excited. The exciting regulating table stands in front of the generator panels, and the back of the switchboard is covered with glass and is dust-proof. Resistances are, when necessary, switched in the sub-station circuits to regulate the volts on the low-tension feeders. There are 15 pilot wires from various feeder points in the district. Most of the sub-stations are connected with the works by means of telephones, and thus the attendants can be communicated with, so that with judicious arrangements of battery charging the resident engineer is able to report that a running station load-factor of over 90 per cent has been obtained.

A small sub-station in a building separate from the works supplies the works lighting and the exciting current for the generators. Including this one, there are 10 sub-stations, at six of which E. P. S. storage batteries are installed with approximate total maximum discharge rate of 180 kw. These batteries are charged by means of boosters run off the 100-volt bus-bars. The booster switch-gear is a

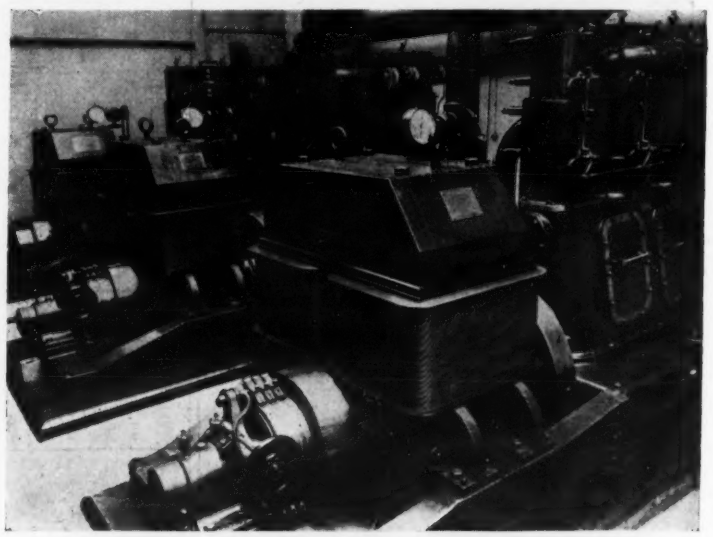


FIG. 8.—DYNAMO ROOM, CRYSTAL PALACE STATION.

specially designed rock-over type of switch, and is fitted with an automatic release worked by a relay connected in series with the high-tension circuit of the transformer, so that in case of failure of the supply to any particular sub-station that battery would be at once switched on to the mains. It also interlocks and prevents the sub-station attendant switching on the booster when the transformer is not running. Only six of the sub-stations are provided with batteries. Most of the sub-stations are connected on the feeder system

to the low-tension network. The largest of the sub-stations is at the Crystal Palace, and was designed for an output of 500 kw. There are four 70 kw, three 40 kw and two 66 kw. fixed ratio E. C. C. transformers. The last-named two machines give 440 volts for arc lighting, etc., and switch gear is provided so that, if necessary, some of the 100-volt machines can be switched in series to furnish a higher bus-bar pressure. The battery room contains 56 E. P. S., 45 plate cells charged by means of a 17-kw double-field booster.

The high-tension feeders vary in size from 0.25 square inch to 0.06 square inch. The 0.25 square inch mains, of which there are three, are Callender lead-covered concentric, drawn into 4-inch cast iron pipes. The smaller mains are British Insulated single cables, lead-covered and steel armored, laid directly in the ground. The lead-covered low-tension cables are being gradually replaced by vulcanized bitumen make, laid solid in masonry troughs. All services are protected by means of fuse boxes connected on to the distributors. The number of lamps connected is nearly 29,000 equivalent 8 cp.

## The New Toll Line Boards of the Chicago Telephone Company.

The Chicago Telephone Company has just put in operation a new method of handling its toll line business, which places its toll office at the head of the toll line offices of the world in the matter of convenient equipment for rapid work. The general plan of handling messages is somewhat similar to that in use in the San Francisco exchange of the Pacific States Telephone & Telegraph Company, described in ELECTRICAL WORLD AND ENGINEER, of May 11, 1901, page 759. The change in Chicago has been made under the direction of Mr. F. W. Alston, superintendent of equipment of the Chicago and Central Union Telephone companies, who came from the Pacific States at the time Mr. John I. Sabin took the presidency of the Central Union and Chicago companies. The toll line room in the San Francisco exchange has been one of the features that attracted special and favorable attention from telephone visitors from other parts of the country, and from Europe, and it is quite natural that Mr. Alston introduced the same ideas in fitting up the new Chicago

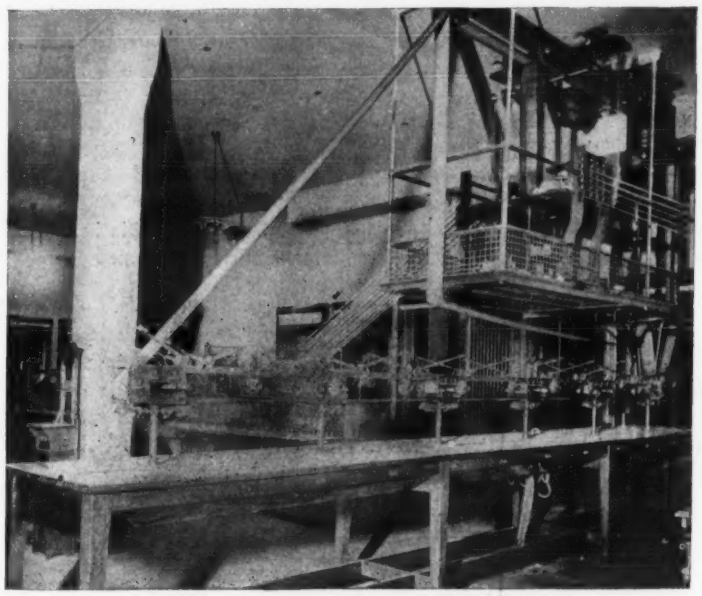


FIG. 1.—TOLL ROOM.

toll room after such a successful experience with it on the Pacific Coast.

Before going into the details of the new equipment, it may be well to call attention to the amount of toll business done by the Chicago Telephone Company over its own lines, which is the greatest in volume of any toll switchboard in the United States. The Chicago Telephone Company's toll lines reach all the numerous towns within a radius of 60 miles of Chicago in the States of Illinois and Wisconsin, with a few lines to nearby towns in Indiana. They reach Rockford on the west, Kankakee on the south, Lake Geneva northwest and Kenosha on the northwest. The directory shows nearly 290 points outside the Chicago Telephone Company's exchange, which are reached by toll lines. The volume of business in number of complete switches per day is the true index of work done, and this averages 5000 in the toll room of the Chicago Telephone Company.

The number of calls per subscriber in the Chicago exchange is higher than in any other large city. In January, 1902, the Chicago exchange, with 37,000 subscribers connected, made an average of 511,000 complete switches per day, and the New York City exchange, with 65,000 subscribers, made 440,000 complete switches per day. This, however, is due to the fact that in Chicago subscribers still revel largely in a flat rate service, whereas all New York is now practically on a measured rate basis.

The new toll room of the Chicago Telephone Company has 72 operating positions and 24 positions where orders for connections

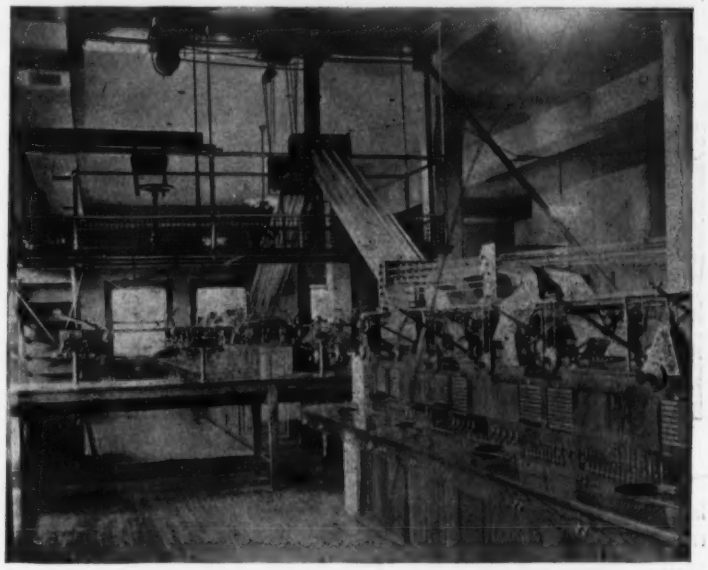


FIG. 2.—TOLL ROOM.

are received and recorded. The general plan of operation is that one set of operators does nothing but make out order tickets for long distance connections as the orders come in from subscribers. These order tickets are carried by traveling belt to a central ticket distributor, who sends each ticket to the toll operator who has the toll line wanted terminating on her section. When the toll operator has secured the toll connection she calls up the local subscriber desiring the connection. To go more into detail: When a request for a toll line connection is received by an exchange operator, she connects the calling subscriber with one of the long distance receiving or recording clerks who are stationed at the 26 positions, some of which are shown in the foreground (Fig. 1). These positions have a row of answering jacks, with lamp signals set in the table in front of each operator. The toll recording or receiving clerk who receives the call puts down the number and name of the party called for, and of the subscriber calling. She then tells the calling party he will be called up when the connection is secured and disconnects. Now comes the method of getting the ticket quickly to the right toll operator, which is the essential feature of the new system. Running over the middle of the table just above the incandescent lamps in Fig. 1 are a pair of endless belts, run one on top of the other, except when passing through the receiving boxes in front of each operator, when one belt is carried up to the top of the box and the other runs in the bottom. The slip of paper thrown in the box is immediately whisked away between the belts up to the central distributing clerk in the elevated office, seen in Figs. 1, 2, 3 and 4. From the distributing clerk's office similar belts run to the 24 positions occupied by the toll operators. The distributing clerk has simply to put the slip in a slot bearing the name of the toll line wanted, and the belt deposits the slip in front of the toll line operator, who has that toll line terminating in front of her. Each of these operators has several toll lines terminating in jacks at the bottom of her section. Figs. 3 and 4 show these operators' sections in detail. Besides the toll line jacks and lamp signals, each section carries multiple trunk jacks, which run to the various exchange offices in Chicago. These trunks come into the toll operating board and appear on the multiple jacks in front of every position on the board. By means of these trunks, the toll line operator can call any office, and through the office any subscriber. When the toll operator receives the order ticket, it is her duty to call

up the toll line party wanted, and when connection is secured, the toll operator calls up the Chicago subscriber who ordered the connection, and conversation is established. Orders for toll line connection are taken up in their regular turn, as they are deposited on the toll operator's desk. Under the old plan with toll lines terminating on multiple jacks in front of a number of toll operators, an operator by good luck in making the busy test might get a toll line ahead of one who had been waiting for it some time. For connecting one toll line with another, a set of trunks runs the length of the operator's board with multiple jacks in front of each operator. In order to know which of these trunks is busy a toll operator depresses a key connecting her with a supervisory clerk who has in front of her

FIG. 3.—TOLL ROOM.

lamp signals connected with all the trunks which indicate when a trunk is busy. The supervisory clerk directs which trunk is to be used in making the connection from one toll board section to another.

The distinctive features of the new toll office are the complete separation of the receiving of orders and the actual work of making toll connection, and the rapid mechanical method of delivering order tickets from receiving clerks to operators.

The conveying belts are practically noiseless. They are driven by small direct-current motors suspended from the ceiling above the distributing clerk's gallery. The arrangement of belts can be seen by a study of the four illustrations shown herewith. For conveying

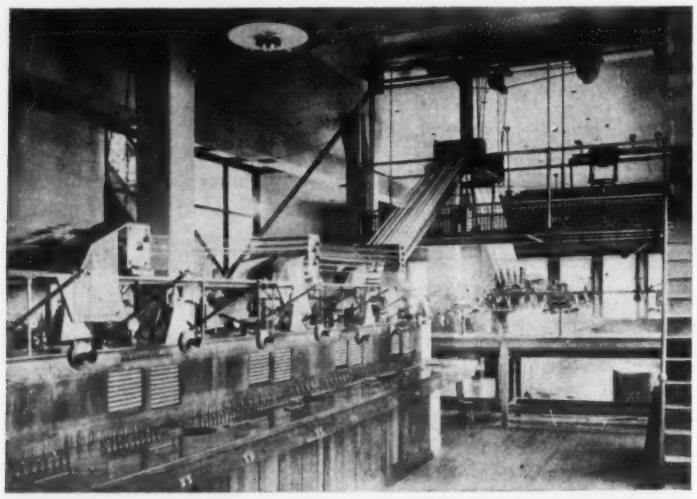


FIG. 4.—TOLL ROOM.

to the distributing clerk one wide belt is sufficient, as all the slips are to be delivered at one place. From the distributing clerk to the 24 operators' positions, 24 belts are run, one for each destination. As shown, these are placed in three tiers of four each.

The long-distance business also goes through this office, but the long-distance switching is done at a long-distance terminal office on the edge of the city. An operator in the toll room reads the orders for long-distance connections to the long-distance terminal office.

The new toll room is much lighter and more comfortable than the old quarters, and is a fitting place in which to carry on the largest toll business in the world.

# The General Problem of Wave Propagation Over Non-Uniform Conductors.

BY M. I. PUPIN.

## I. NON-UNIFORM CONDUCTORS OF THE SERIES TYPE

THE most general form of a non-uniform wave conductor of the series type is represented in Fig. 1. It consists of two different sets of uniform conductors, set *ab, cd,* . . . . represented by thick lines, and set *bc, de,* . . . . represented by thin lines. The members of each set are equal to each other.

This paper shows that the mathematical solution of the problem of wave propagation over such a conductor is the most general solution, because every other case can be deduced from it.

A discussion of this general problem seems necessary, because it exhibits clearly the relation between the various forms of non-uni-

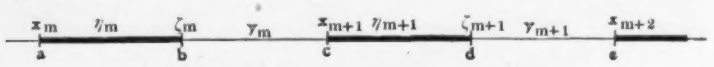



FIG. 1.—DIAGRAM OF NON-UNIFORM CONDUCTOR.

form conductors of this type, and demonstrates that they are all subject to the same general rule, which will be formulated further below. In order to make the discussion more complete the effect of leakage is also considered.

Section 1. *Wave porpagation over uniform conductors possessing uniformly distributed leakage.*

The problem of wave propagation over a uniform wave-conductor, with uniformly distributed leakage, was first solved by Oliver Heaviside. A brief statement of this theory will be given here first, in order to explain briefly the effect of the leakage current upon the mathematical treatment of the problem in this case, and thus pave the way for the more general discussion.

The same symbols will be employed as in Section 1, Part II., of my paper read before the American Institute of Electrical Engineers, May 18, 1900, and published in Vol. XVII. of the *Transactions* of this Society.

The principle of equality of actions and reactions in any element of the conductor is expressed by

$$L\frac{dy}{dt} + Ry + \frac{\delta V}{\delta s} = 0 \qquad (1)$$

We have also the following relation between the current $y$ and the potential $V$,

$$-\frac{\delta y}{\delta s} = C\frac{dV}{dt} + aV \qquad (2)$$

where $a$ is the leakage conductance per unit length. This investigation is limited to waves of the simple harmonic type, hence

$$u = -\frac{\delta y}{\delta s} = (ipC + a)V = \sigma V \qquad (3)$$

The operator $(ipC + a)$ shows that the lateral current $u$ consists of two components, one in phase with $V$ and the other in quadrature. *The energy accompanying the first is dissipated, and that accompanying the last is stored up.*

From (1) and (3) we obtain

$$L\frac{dy}{dt} + Ry = \frac{1}{\sigma}\frac{\delta^2 y}{\delta s^2} \qquad (4)$$

Therefore,

$$y = Ae^{i(pt+\mu s)} \qquad (5)$$

will be a solution if

$$\sigma v = (ipC + a)(ipL + R) = -\mu^2 = (i\alpha + \beta)^2 \qquad (6)$$

This may be called the equation of propagation because it expresses a relation between $\alpha$ and $\beta$, the characteristic constants of wave propagation, and the constants of the wave conductor, namely, $C$, $L$, $R$, and $a$.

Equation (6) can also be written

$$(i\alpha + \beta)^2 = ipC\left\{ ip\left(L - \frac{aR}{p^2C}\right) + R + \frac{aL}{C}\right\}$$
$$= ipC(ipL_1 + R_1) \qquad (7)$$

The equation of propagation is now of the same form as in the

case of a perfectly insulated conductor. *The effect of leakage is, therefore, to diminish the effective inductance and to increase the effective resistance of the conductor.*

It can be seen, however, that the change in inductance produced by leakage is insignificant when compared with the change in the resistance. The fact that this increase in the effective resistance produced by leakage is proportional to the inductance introduces the well-known difference between a leaky wave conductor and a perfectly insulated one. In this one the efficiency of transmission increases indefinitely with the increase of inductance; in that one there is a definite limit beyond which an additional increase of inductance will be harmful.

If by $(\beta)$ we denote the minimum value of the attenuation constant $\beta$, then it is easily shown that

$$(\beta) = \sqrt{a\,R}$$

and the limiting value of the inductance is given by the equation

$$L = \frac{R\,C}{a}$$

In this case the attenuation is independent of the frequency, and we have Heaviside's distortionless circuit.

In submarine cables and in telephone cables the insulation resistance is so high that $a$ is extremely small, and the limiting value of $L$ is far beyond practicable limits. But in the case of air lines there is, on account of low insulation resistance, a definite practical limit. Thus let the line have the following constants per mile:

$$R = 2$$
$$C = .01 \times 10^{-6}$$
$$a = \frac{1}{2.5 \times 10^{6}}$$

This corresponds approximately to a long-distance telephone line. In this case the limiting value of the inductance is

$$L = .05$$

This is about 25 times as much inductance as long-distance telephone lines have, but it is by no means more than the inductance which can be put quite readily upon a telephone line by the introduction of inductance coils. Hence, if it should be required to load a telephone line of the above description with inductance coils and introduce more than .05 henrys per mile, then it would seem as if the insulation resistance will have to be larger than 2.5 megohms per mile. It is important, therefore, to develop the mathematical theory of wave propagation over a non-uniform conductor possessing leakage.

It should be observed here that long-distance telephone lines have an average leakage resistance considerably larger than 2.5 megohms.

Section 2. *Wave propagation over a non-uniform conductor of the most general series type, possessing leakage.*

Referring to Fig. 1 it will be seen that the currents at any point of the shaded and unshaded portions of the conductor are denoted by $\eta$ and $y$, respectively. Thus $\eta_m$ denotes the current at any point of a shaded section like $cd$, and $y_m$ denotes the current at any point of a section of the type $bc$. The constants of these sections are distinguished by suffixes. Thus $L$, $R$, $C$, $a$, are the inductance, resistance, capacity and leakage conductance, per unit length, of any unshaded section like $bc$. Its length is $l$. The corresponding quantities for the shaded sections like $cd$ are denoted by $L_1\ R_1\ C_1\ a_1\ l_1$. The currents at the homologous boundary points $a\ c\ e\ \ldots\ bd\ \ldots\ \ldots$ are denoted by $x_m\ x_{m+1}\ \ldots\ \zeta_m\ \zeta_{m+1}\ \ldots$

Referring now to Section III. of my paper, cited above, it will be seen that

$$y_m = \frac{\zeta_m \sin \mu (l-\xi) + x_{m+1} \sin \mu \xi}{\sin \mu\, l} \qquad (1)$$

$$\eta_m = \frac{x_{m+1} \sin \mu_1 (l_1-\xi) + \zeta_{m+1} \sin \mu_1 \xi}{\sin \mu_1\, l_1} \qquad (2)$$

Boundary condition at point $c$ is expressed by

$$\frac{1}{\sigma}\left(\frac{\delta y_m}{\delta \xi}\right)_{\xi = l} = \frac{1}{\sigma_1}\left(\frac{\delta \eta_m}{\delta \xi}\right)_{\xi = 0} \qquad (3)$$

where

$$\sigma = i\,p\,C + a$$
$$\sigma_1 = i\,p\,C_1 + a_1$$

Equation (3) gives

$$(\mu\,\sigma_1 \sin \mu_1 l_1 \cos \mu\, l + \mu_1\,\sigma \sin \mu\, l \cos \mu_1 l_1)\, x_m +$$
$$- \mu\,\sigma_1 \sin \mu_1 l_1\, \zeta_m - \mu_1\,\sigma \sin \mu\, l\, \zeta_{m+1} = 0$$

$$\left.\begin{array}{rl} \text{or,} & A\,x_{m+1} - B\,\zeta_m - C\,\zeta_{m+1} = 0 \\ \text{similarly,} & A\,x_m - B\,\zeta_{m-1} - C\,\zeta_m = 0 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{array}\right\} \qquad (4)$$

These equations may be called homologous, because they express the boundary conditions at the homologous points $a$, $c$, $e$, . . . .

Boundary condition at $d$ is expressed:

$$\frac{1}{\sigma_1}\left(\frac{\delta \eta_m}{\delta \xi}\right)_{\xi = l_1} = \frac{1}{\sigma}\left(\frac{\delta y_{m+1}}{\delta \xi}\right)_{\xi = 0}$$

This boundary equation gives:

$$\left.\begin{array}{rl} & A\,\zeta_{m+1} - B\,x_{m+2} - C\,x_{m+1} = 0 \\ \text{Similarly,} & A\,\zeta_m - B\,x_{m+1} - C\,x_m = 0 \\ & \ldots\ldots\ldots\ldots\ldots\ldots \\ & \ldots\ldots\ldots\ldots\ldots\ldots \end{array}\right\} \qquad (5)$$

This is also a system of homologous equations representing the boundary conditions at the homologous points $b$, $d$, . . . .

From (4) and (5) result the following two systems of equations between homologous boundary currents:

$$\left.\begin{array}{l} \dfrac{A^2 - B^2 - C^2}{B\,C}\, x_m - x_{m-1} - x_{m+1} = 0 \\ \dfrac{A^2 - B^2 - C^2}{B\,C}\, x_{m+1} - x_m - x_{m+2} = 0 \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \end{array}\right\} \qquad (6)$$

$$\left.\begin{array}{l} \dfrac{A^2 - B^2 - C^2}{B\,C}\, \zeta_m - \zeta_{m-1} - \zeta_{m+1} = 0 \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \end{array}\right\} \qquad (7)$$

These two systems are of the same form as system (6), Section 2, Part II., of my paper referred to above. We can write, therefore,

$$\left.\begin{array}{l} x_m = K_1 \cos 2\,m\,\theta + K_2 \sin 2\,m\,\theta \\ \zeta_m = K_3 \cos 2\,m\,\theta + K_4 \sin 2\,m\,\theta \end{array}\right\} \qquad (8)$$

where $K_1\ K_2\ K_3\ K_4$ are constants, which must be determined from the conditions at the transmitting and at the receiving terminals of the non-uniform conductor.

In order that (8) represent the solution of (6) and (7) we must have

$$\frac{A^2 - B^2 - C^2}{B\,C} = 2 \cos 2\,\theta$$

Giving $A$, $B$ and $C$ their values and introducing for convenience $l = l_1$ we obtain

$$(\sigma\,\nu_1 + \sigma_1\,\nu)\,\frac{\sin \mu\, l \sin \mu_1\, l}{\mu\,\mu_1} + 2 \cos \mu\, l \cos \mu_1\, l = 2 \cos 2\,\theta \qquad (9)$$

This is the most general equation of wave propagation over a non-uniform conductor of the series type. Every other case can be derived from it as will be shown now.

First Case.—*The conductor consists of equal resistance coils connected in series, each coil having a resistance equal to* 1 R. *Equal condensers of capacity* 1 $C_1$, *and leakage conductance* 1 $a_1$, *connect the conductor to ground, one condenser at each juncture between two consecutive resistance coils.* This is the well-known arrangement which has for so many years been employed as artificial cable.

We can pass from the general arrangement of Fig. 1 to this arrangement by making $C = L = a = 0$ and $L_1 = R_1 = 0$. Hence

$$\sigma = 0$$
$$v = R$$
$$\sigma_1 = i\,p\,C_1 + a_1$$
$$v_1 = 0$$
$$\mu = 0$$
$$\mu_1 = 0$$
$$\frac{sin\ \mu\ l}{\mu} = \frac{sin\ \mu_1\ l}{\mu_1} = l$$
$$cos\ \mu\ l = cos\ \mu_1\ l = 1$$

Equation (9) reduces, therefore, to

$$R\ (i\,p\,C_1 + a_1)\ l^2 + 2 = 2\ cos\ 2\ \theta$$

or
$$-R\ (i\,p\,C_1 + a_1)\ l^2 = 4\ sin^2\ \theta$$

$\theta$ is a complex angle; putting it equal to $= \frac{1}{2}\ (a - i\,\beta)l$ makes $a$ and $\beta$ the characteristic constants of wave propagation over a non-uniform conductor of this kind.

When there is a sufficiently large number of resistance coils per wave-length, the wave-length being estimated on the corresponding uniform cable having a capacity $C_1$, leakage conductance $a_1$, and resistance $R$ per unit length, then $sin\frac{1}{2}\ (a - i\,\beta)\,l$ is so small that we can put, approximately,

$$sin\ \frac{1}{2}\ (i\,a - \beta)\ l = \frac{1}{2}\ (a - i\,\beta)\ l \qquad (10)$$

Equation (10) reduces to

$$-\ (i\,p\,C_1 + a_1)\ R = (a - i\,\beta)^2 \qquad (11)$$

But this is the equation of propagation over the corresponding uniform cable. In other words, the non-uniform conductor is equivalent to its corresponding uniform cable. All experimental data obtained with an artificial cable of this kind have the same intrinsic weight as those obtained with the real cable, which corresponds to this article cable, that is, provided that the frequencies employed are withi nthe limit defined by (10).

*Example.*—Suppose it is required to make an artificial cable which shall be equivalent to a real submarine cable up to a frequency of 25 p. p. s. The submarine cable has a resistance of 5 ohms, a capacity of .3 microfarads, and an insulation resistance of $10^8$ ohms per mile. The wave-length on the corresponding uniform cable corresponding to a frequency of 25 p. p. s. is very nearly 1020 miles. Sixteen resistance coils and condensers per wave-length gives a close approximation. Therefore, each resistance coil should have a resistance, and each condenser should have a capacity of 64 miles of cable, that is, a resistance of 320 ohms and a capacity of 192 microfarads. The insulation resistance of each condenser should be $\frac{10^8}{64}$ ohms.

Second Case.—*Add in the preceeding case to each resistance coil another coil of resistance* l $R_1$, *and inductance* l $L_1$. Equation (10) becomes now

$$-l^2\ \left\{(i\,p\,C_1 + a_1)\ (i\,p\,C + R + R_1)\right\} = 4\ sin^2\ \frac{1}{2}\ (a - i\,\beta)\,l \qquad (12)$$

This case is identical with the one which I discussed in Sections 2 and 3 of my paper read before the American Institute of Electrical Engineers on March 22, 1899, and also in Section 2, Part II., of the paper cited above, except that leakage was neglected there. It is evident, therefore, that the construction of the artificial line described in Sections 2 and 3 of my paper of 1899, is equivalent to loading a uniform cable with inductance coils at periodically recurring intervals, the length of these intervals being small in comparison with the wave-length.

Third Case.—*A uniform wave conductor possessing uniformly distributed leakage has condensers of capacity* l $C_1$, *and leakage conductance* l $a_1$, *at periodically recurring intervals of length* l *connecting the conductor to ground.*

The equation of propagation for this case is obtained from (9) by putting $\sigma_1 = i\,p\,C_1 + a_1$, $\mu_1 = v_1 = 0$, $sin\ \frac{\mu_1\,l}{\mu_1} = l$, as follows:

$$\sigma\ v\ l\ \frac{sin\ \mu\ l}{\mu} + 2\ cos\ u\ l = 2\ cos\ 2\ \theta \qquad (13)$$

When the distance $l$ is small in comparison with the wave-length on the conductor before the introduction of the condensers, then

$$\frac{sin\ \mu\ l}{\mu} = l$$
$$2\ cos\ \mu\ l = 2 - \mu^2\ l^2 = 2 - \sigma\ v\ l^2$$

Equation (13) reduces, therefore, to

$$-\ v\ (\sigma + \sigma_1)\ l^2 = 4\ sin^2\ \theta = 4\ sin^2\ \frac{1}{2}\ (a - i\,\beta)\ l$$

If, again, the distance $l$ is sufficiently small in comparison with the wave-length on the uniform conductor corresponding to this loaded conductor, then we can write

$$-v\ (\sigma + \sigma_1) = -(i\,p\,C + R)\left\{i\,p\,(C + C_1) + a + a_1\right\} = (a - i\,\beta)^2 \qquad 14)$$

Equation (14) shows that the wave propagation on a loaded conductor of this kind is approximately the same as on the corresponding uniform conductor.

An interesting illustration of a non-uniform conductor of this kind is the following: Suppose a number of inductance coils are wound bifilarly, so-called twin coils, so as to give each half of each coil the following constants:

$l\,L_1$ = effective inductance of each coil.
$l\,C_1$ = effective capacity of each coil.
$l\,R_1$ = effective resistance of each coil.
$l\,a_1$ = leakage conductance of each coil.

Introduce them into the line represented in Fig. 1 in place of the shaded portions so that one-half of the twin coil is on one leg of the uniform line and the other half is in the other. Now, short circuit each half, then we have a non-uniform conductor of the description just given, that is to say, a non-uniform conductor, which is equivalent to a uniform conductor having the following constants:

$L$ = inductance per unit length.
$R$ = resistance per unit length.
$C + C_1$ = capacity per unit length.
$a + a_1$ = leakage conductance per unit length.

Provided that $l$ is small in comparison with the wave-length on this uniform conductor.

Fourth Case.—Suppose now that the short-circuiting wires are removed, introducing thus the inductance $l\,L_1$, and the resistance $l\,R_1$, of the coils into the circuit. This is equivalent to loading the uniform line just described with perfectly insulated inductance coils. If the wave-length on the uniform conductor which corresponds to the resulting non-uniform conductor is large in comparison with the distance between the coils, then equation (9) gives

$$-l^2\ \left\{-\ (\sigma\ v_1 + \sigma_1\ v) - \sigma\ v - \sigma_1\ v_1\right\} = -\ 4\ sin^2\ \theta$$

$$\text{or, } -\ (\sigma + \sigma_1)\ (v + v_1)\ l^2 = 4\ sin^2\ \theta = 4\ sin^2\ \frac{1}{2}\ (i\,a - \beta)\ l$$

$$\text{or, } -\ (\sigma + \sigma_1)\ (v + v_1) = (a - i\,\beta)^2$$

This is the equation of propagation over a uniform line having the following constants:

$L + L_1$ = inductance per unit length.
$R + R_1$ = resistance per unit length.
$C + C_1$ = capacity per unit length.
$a + a_1$ = leakage conductance per unit length.

A careful analysis of the last two cases shows that if we have two different sets of coils similar to the twin coils described above we can by proper combinations investigate experimentally most of the problems which may arise in connection with the general theory of wave propagation over non-uniform conductors. The results obtained that way will have the same weight as if they were obtained on

actual air lines or submarine cables. Coils of that description can be made very easily. It is preferable to wind them not on a wooden spool but in the manner indicated in Section 1, Part I., of my paper of May, 1900, referred to above. Each coil when finished should be carefully boiled in beeswax. It will maintain then a fairly high and steady insulation resistance, and a steady capacity. Iron cores should be avoided if the coils are to be employed for lecture room purposes as well as for investigation.

It will be seen that non-uniform conductors follow the same rule with regard to leakage as their corresponding uniform conductors. The limitations imposed by insulation resistance upon the amount of inductance which can be introduced by loading is of no consequence in the case of telephone and submarine cables. Even in the case of properly insulated long-distance telephone and telegraph lines the upper limit of inductance allowed by leakage is as high as other practical considerations will sanction. But it is nevertheless important to keep in mind that heavy loading requires high insulation.

The preceding results can be summed up as follows: A non-uniform wave conductor is a conductor made up of periodically recurring sets of preferably equal parts, which may be called its component parts. Each component part has definite reaction constants, that is, definite resistance, capacity and leakage conductance, and corresponds, therefore, to a definite part on the corresponding uniform conductor. Any two consecutive sections on the non-uniform conductor have, therefore, a perfectly definite angular distance, as defined in my papers, cited above. This paper demonstrates that the rule of equivalence between any non-uniform conductor and its corresponding uniform conductor can be expressed mathematically in terms of this angular distance by the same equation which was established in these papers for the particular cases discussed there. This mathematical rule translated into English says that the length on the uniform conductor corresponding to any two consecutive sections of the non-uniform conductor must be small in comparison with the wave-length. One-sixteenth of the wave-length is a close approximation. Smaller approximations permit larger sub-divisions. Four sub-divisions per wave-length is a worse approximation. For any sub-division consisting of between four and sixteen sections of two component parts per wave-length, the approximation can be calculated by the mathematical rule just cited, with an accuracy which will be sufficient for all practical purposes, particularly if the number of sub-divisions is not too near four.

When this rule is fulfilled, then it does not matter how the reaction constants of any one of the sections are distributed within that section; *they may be lumped or uniformly distributed.* This principle has long ago been recognized in all engineering practice dealing with alternating-current transmission of power over distances which are small in comparison with the wave-length on the transmission wire connecting the transmitting and the receiving apparatus to each other. In all such cases, the inductance and resistance of the transmission wire was replaced by a coil of the same inductance and resistance, and the capacity and leakage conductance of the transmission wire was replaced by a condenser of the same capacity and leakage conductance, the condenser being connected between a terminal of the coil and the ground. The theory of wave propagation over non-uniform conductors, in its most general aspect, is, therefore, nothing more nor less than an extension of this well-known engineering practice.

## Wireless Telegraphy on the Kronprinz Wilhelm.

Several interesting tests were made on the "Kronprinz Wilhelm" on her voyage across last week with Prince Henry of Prussia on board, in the use of wireless telegraphy, and the Marconi wireless telegraph operators on board were much elated with the workings of the system. On leaving Bremen the operators got in touch with the station on the Borkum Lightship. They kept up communication for three hours, during which time many messages were received for passengers and many were transmitted for delivery ashore. The next station communicated with was on the English coast at North Foreland. Talk with station was maintained until the instrument began to tick the call from Niton on the Isle of Wight. The next station to be called was the Lizard, and in the communication with it all records of talking from ship to shore were broken. When 100 miles off the Lizard, and an animated conversation was being carried on, the induction coil of the "Kronprinz's" instrument broke down and the operators had to stop temporarily for repairs. When the instrument was ready for use again the liner was 300 miles off the Lizard, and the operator at the instrument was much surprised when a plain signal was received from the station. When 310 miles distant this message was received: "Stand by a moment; I have got to fix apparatus."

The next day, the 19th, the "Lucania" was picked up and messages of greeting between Prince Henry and that vessel were exchanged. Another message to the captain was received from the "Lucania," telling him to look out for a sunken schooner in 30.32 north, 73.10 west. The "Kronprinz" also got in communication at the same time with the "Campania," which was coming this way.

On Saturday morning at 10.30 o'clock, while 70 miles from the "Campania," she again got in communication with her, but could not understand her signals. Communication was begun with Nantucket at 9 P. M. on Saturday night, but the first working message could not be got through until 11.30. Prince Henry sent a message to the President.

On board the "Kronprinz Wilhelm," off Nantucket Island, via Marconi Station, Siasconset, Feb. 22.

PRESIDENT ROOSEVELT:

Hope state of health of Master Roosevelt favorably progressing with speedy recovery. Permit me to congratulate you and American Nation of to-day's commemoration of Washington's Birthday. Sorry disappoint you so late arrival. Very heavy persistent easterly winds which make fast progress impossible even for this beautiful vessel. I look forward to meet you.

HENRY OF PRUSSIA.

The President replied:

WHITE HOUSE, Feb. 22.

PRINCE HENRY OF PRUSSIA, the "Hohenzollern, New York City.

Accept my heartiest greetings on your safe arrival. I thank you for your message. In the name of the American people I will see you, and I look forward to meeting you personally to-morrow.

THEODORE ROOSEVELT.

It would appear, however, that although the "Hohenzollern," the Emperor's yacht lying in port in New York, has a Marconi set on board, of the usual character, it was not used, as the "Kronprinz" approached, for fear of interfering with the signals to and from that ship and the Nantucket Light Station.

## Mr. Marconi on Wireless Telegraphy

In London, on Feb. 21, at a general meeting of the Marconi Wireless Telegraph Company, Mr. G. Marconi, referring to the transatlantic experiments, announced that the next series of tests would include the transmission of words and messages. He added that there was nothing to prevent the company from undertaking commercial communication with ships at sea. The system at present was in permanent use on board 70 ships, and there were 25 land stations. His transmission of 22 words in a minute did not compare badly with the work of the cables.

The defects with reference to secrecy, said Mr. Marconi, had been removed. After perfecting arrangements in Canada he would challenge Sir William Preece and Professor Lodge to intercept messages. He added that the monopoly claimed by the British postal-telegraph system had hitherto impeded the establishment of a wireless service in England and Ireland.

Mr. Marconi complained that obstruction was thrown in his way on that side of the Atlantic, which was in marked contrast to the generous encouragement which he had received from the governments and press of the United States and Canada.

In regard to the commercial side of the system, Mr. Marconi said that on the recent arrival of an American liner upward of 8000 words were received within 16 hours. The transmission of this number of words daily across the Atlantic would represent an annual income of £73,000 for each pair of stations, and the company, in the first instance, was proceeding to install two pairs of stations.

A special cable message says as to the challenge above referred to: "As to the assertion that wireless telegraphy could not be commercially valuable, inasmuch as any one with an installation could read the messages, he said he had overcome that by a synchronic device, and challenged Sir William Preece or Professor Lodge to make a trial if they thought that, after giving him a week's notice, they could steal, intercept and read the messages passing between two of his stations. He was willing to place the adjacent station at their

disposal, and let them try. Mr. Marconi's speech made quite a sensation, and he is said to have promised that wireless telegraphy in the future would apparently be achieved despite the opposition of enormous vested interests."

The German Navy Department has decided to establish a chain of wireless telegraph stations along the entire German coast. For the last few days trials have been conducted at Kiel to determine whether the department shall use the Braun system or the Slaby-Arco system, in the latter of which Emperor William has shown great interest. Thirty-two German warships have already been equipped with the Slaby-Arco system, while eight more are to have this system installed. Official reports say that the Slaby-Arco system gives the more satisfactory results.

## Power Transmission Plant for Lighting the Cornwall Canal, Canada.

An interesting installation of American apparatus in Canada is that to which reference has already been made in these columns, for lighting the Cornwall Canal. The plant is now in full operation and the illustration herewith shows one of the generators and exciters in place direct connected to the waterwheel shafts. Three additional units similar to this are to be installed later. The large rotating field generator has a capacity of 1000 kw, or about 1350 hp, and runs at 180 r. p. m. Having 40 poles, it gives a frequency of 60 cycles per second, delivering current at the bus-bars at a potential of 2200 volts. The exciters have a capacity of 50 kw, and are sufficient to excite four generators similar to the one described. Two exciters have already been installed so that in case of accident to the exciter or wheels connected with it, the other unit can be immediately put into operation.

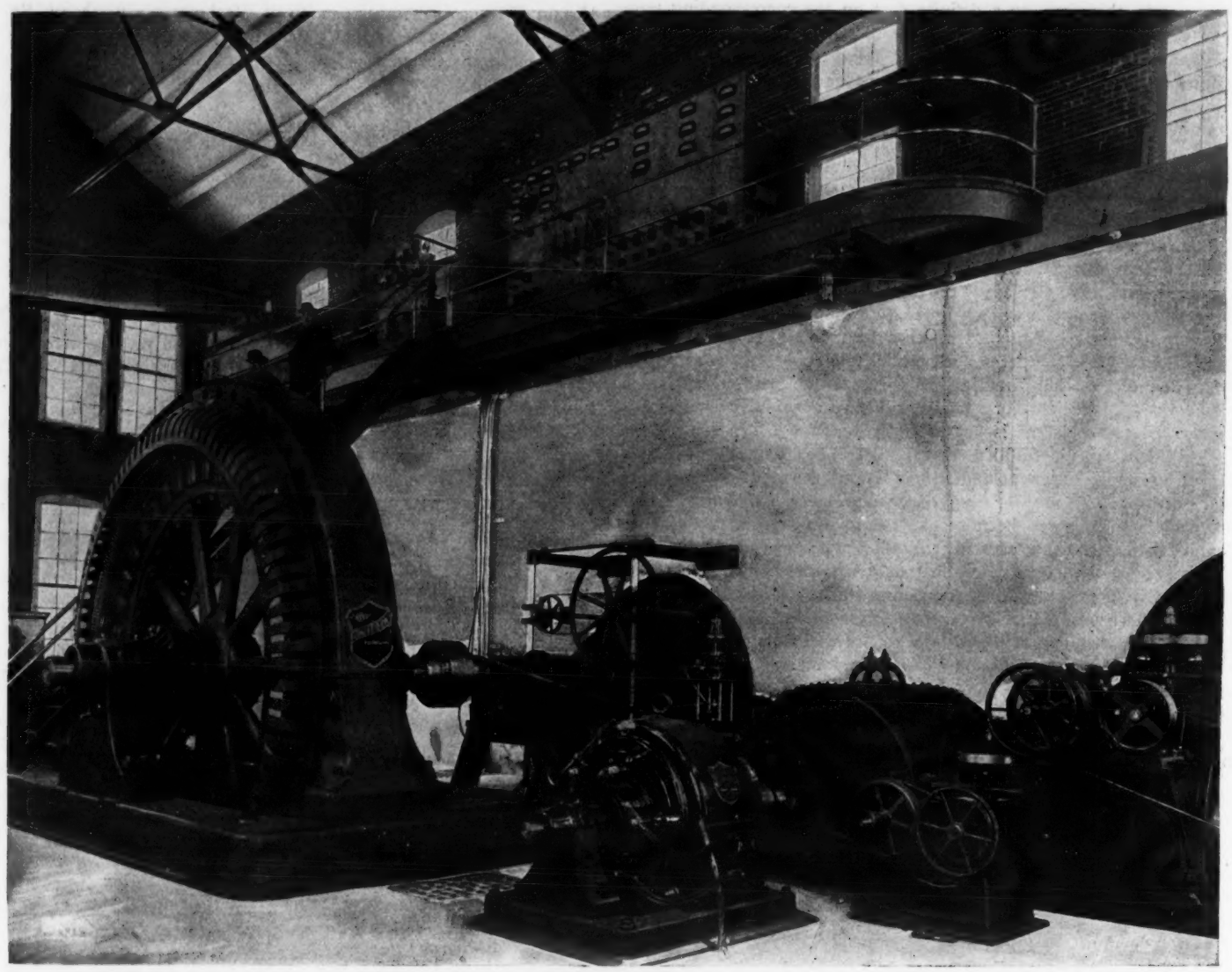


FIG. 1.—INTERIOR OF STATION.

At the switchboard, connections are made with cables leading to the wire tower, on the second floor of which are located the raising transformers which increase the pressure from 2200 volts to 11,000 volts for the power transmission circuits, and to 8800 volts for use in connection with the 100 light circuits of series enclosed alternating arc lamps, 250 of which are at present distributed along the canal banks and at the locks, bridges and guard gates for lighting the Cornwall Canal. The power circuits distribute current for operating canal gates, swinging the bridges and controlling the weirs at the various points from Lock No. 15 to Lock No. 21, a distance of about 11 miles, step-down transformers being provided at the locks to reduce the line pressure from 11,000 volts to 550 volts, at which it is used in the induction motors. This work does not utilize the full capacity of one generator, but it is proposed to shortly install additional generator capacity so as to provide power for other enterprises which are now operating by steam, or which may later be attracted to the spot by moderate priced power delivered electrically in shape ready for utilization in various classes of industry.

The power house building is 40 ft. by 90 ft., built of brick above the line of cut stone arches over the tail-race, and has a steel frame which supports a 25-ton traveling crane running the whole length of the building, and is covered by a steel trussed roof of heavy plank, the whole construction being practically fireproof. On the side of the power house next to the head-race is located a steel framed tower, 13 ft. by 15 ft., with brick walls three stories in height, the lower story of which is occupied by the high-potential switchboard, and the next story by step-up transformers, while the top story is devoted to lightning arresters and the ends of the cables distributed onto arms which support the transmission lines so that they leave the tower from the two opposite sides to serve lines running in opposite direction from the power house.

The main floor of the power house is occupied by the generators, exciters and governors for the waterwheels, the bulkhead extending

about 8 ft. into the power house, the top of which at an elevation of about 19 ft. above the main floor, serves as a switchboard gallery, the width being increased about 4 ft. by brackets, over which the floor is extended. Communication between the gallery and main floor is obtained by means of an iron staircase at the center with brass railing, which also extends around the gallery to both ends of the power house where there are iron ladders on the face of the bulkhead, giving additional means of communication from the generating floor to the switchboard gallery.

The switchboard is of the Wagner type with illuminated dial dead-beat instruments for indicating the current in each phase on the generator panel, a voltmeter switch being provided so the single voltmeter indicates the voltage on any phase. Totaling wattmeters are also located on the generator panels, as well as static ground detector, synchronizing lamps and main switch of the oil type and double break knife switch for generator fields. A double-throw switch provides for lighting the station either from the exciter circuits or from a transformer on the generator circuit.

The exciter panel has a direct-current voltmeter and ammeters for each exciter with double-throw switch, so either exciter can be used on any generator or both can be run together to excite all the generators. The feeder panels have ammeters in each phase and oil switches for opening and closing the circuits, as well as expulsion fuse-blocks in each phase. One panel feeds the Milleroches power and lighting circuit at 2200 volts, another connects the 11,000-volt, step-up,

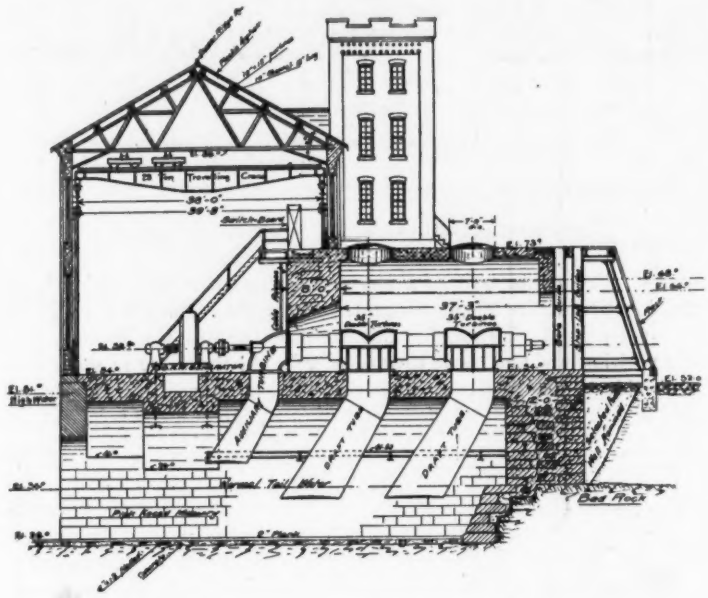


FIG. 2.—SECTION OF STATION.

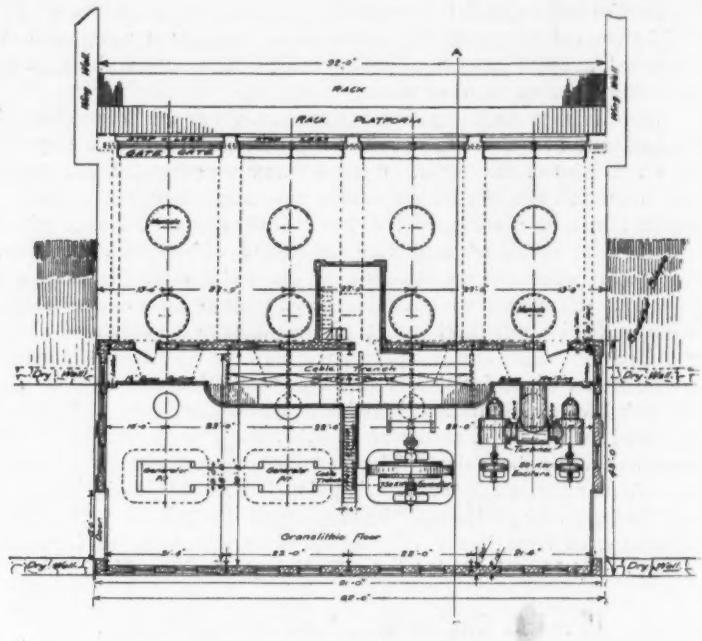


FIG. 3.—PLAN OF STATION.

air-cooled transformers in the tower with the 2200-volt bus-bars, while another connects the three 60-kw, 8800-volt arc lighting transformers to the bus-bars, space being left for five additional feeder panels.

The arc switchboard and regulators are located beyond the space left for additional generator panels at the left of the gallery—the circuits being controlled by plug switches, which are also used for making up connections to the transformers. Hot-wire ammeters are used to indicate the current in each circuit, and a static ground detector provided with plugs for each circuit. The arc regulators are finely finished with blue Vermont marble tops to match the switchboards and polished brass trimmings.

In the lower floor of the tower is located a high-tension plug switchboard with enclosed fuses for making up circuits on the 11,000-volt power lines and for connecting primaries of transformers to cables; but these switches will seldom, if ever, be used for opening circuits as the oil switches on the main switchboard will serve to open the circuit on the low-tension side at the bus-bars. It is expected later to install dummy panels in the main switchboard to operate electrically-controlled automatic overload switches built in brick compartments in the tower.

The load-covered cables connecting the dynamos and exciters with the switchboard are hung in brackets located in trenches left in the concrete, and ascend on the face of the bulkhead, where they are distributed from a central point in either direction through a trench back of the switchboard, which is covered with hardwood gratings oiled and shellacked. The cables are also supported in brackets and stanchions in regular order in this trench, which also conducts the cables from the switchboard into the space below the ground floor of the wire tower, up the sides of which the cables are supported on insulating brackets until they reach the top floor where the three wires in each cable are separated at the cable heads and connected to the outside lines on the arms inside near the ceiling of the top floor. Iron brackets outside of the tower near the top support two timbers, one above the other, into which the insulator pins are inserted, below which a platform outside the upper windows is located at a convenient height, making the wires accessible for connections, etc.

The line construction is plain and substantial. Shaved cedar poles are used with the exception of a few iron structures at the bridge piers and locks. All poles are exceptionally straight and stocky, and are located 100 ft. apart on the canal banks, each pole being located and lined by the Government engineers. All poles on curves are guyed with galvanized signal strand, and where guy stubs are not used two globe strain insulators are used to insulate the guys anchored in the ground. All the poles are painted, and lamp poles are stepped and pipe brackets 2½ ft. long support the lamps, which are hung on Cutter porcelain insulating hangers, in addition to the loop and porcelain insulator on the lamp. Six-pin arms are used on the line with pins 16 inches on centers and braced with steel braces. Double arms are used on all sharp turns bolted through the poles and at the ends. The upper cross-arm carries the two three-phase 11,000-volt lines, and the arm below carries the arc circuits except near the two ends of the line, where one-half of the arm is used for three-phase and the other for arc circuits. No. 6 medium hard-drawn bare copper wire is used for both arc circuits and power feeders, supported on 4½-inch triple petticoat glass insulators.

The total line drop is about 5 per cent, and in some cases less, but on account of mechanical strength it was not deemed advisable to reduce the size of the copper. A line of barbed wire is stretched the whole length of the line on insulators on the pole tops and grounded at every fourth pole as a protection from lightning, though lightning arresters are provided at the power house and at the cable crossings. The high-potential lines cross the canal in paper-insulated lead-covered and armored cables and provision is made for tying the lines together at various points so that in case of breakdown the lines can be connected so as to work around the point in trouble.

At each lock little sub-stations or cabins are located to contain the transformer fuse boards and switchboards for controlling the motors for operating the gates, etc. These cabins also serve to cover the joint in the cables, which passing through the floor go underground to the masonry walls of the locks, then through the course below the coping stone and down the spare stop log checks at the head of the lock, crossing on the bottom out of danger of injury, as they are below the level of the top of the breast wall and covered with a 10 by 12-inch timber, thence up the other side in the check in the masonry to

the same level as the starting point, then through the wall and earth into another switchboard cabin on the island between the two locks. The motors on each side of the two locks and at the weirs are controlled from separate switchboards though the cabins between the two locks, side by side, contain switches for motors operating one side of each lock.

The three-phase high-potential is reduced in a bank of three transformers from 11,000 to 550 volts, and only the lower voltage distributed about each group of locks, except for series arc lighting which crosses back and forth for each lock and bridge pier.

Near the easterly end of the line a spare cable is laid across in a trench dug in the mud bottom of the canal to connect the circuits on the north bank to the south bank in case of trouble in either line.

The horizontal waterwheels for this plant were furnished by the William Hamilton Manufacturing Company, Limited, of Peterboro, Ont., and operate under a working head of 30 ft. They are arranged in two pairs with a fifth wheel used only in case of high back water, the draft tubes of which pass through the concrete arches below the floor of the power house and empty into what was formerly the river bed of the St. Lawrence, a dam having been built just above the power house by the Government for the purpose of widening the canal, which cut off the channel between the Canadian shore and Sheiks Island, leaving a large lake on the up-stream side of the power house, so that with the still water in this lake troubles from ice, which are such frequent evils in connection with most Canadian power plants, will be entirely overcome.

The Cornwall Canal is part of the deep waterway system of the St. Lawrence connecting the great lakes with ocean navigation at Montreal, and has locks capable of handling vessels 250 ft. long, 30 ft. wide and drawing 14 ft. of water.

The head race for the power house is cut from the broad channel leading to the canal waste weir, and is paved with stone on a slope of 2 to 1 to protect the banks. A steel frame supports the fine racks, back of which are located the head gates operated by heavy gearing which admit of cutting off the water from any of the four-wheel chambers to admit of inspection or repairs of any of the wheels. Valves are provided for drawing off the water after the gates are closed as well as valves for refilling. The register gates on the wheels are operated by rods passing through the plates in the bulkhead where they are attached to the Lombard governors for regulating the speed.

The power plant for this interesting installation was built by the Bullock Electric Manufacturing Company, of Cincinnati, and we are indebted to Mr. R. T. Lozier and Mr. F. H. Leonard, E. E., of that concern for the above data. The transformer plant was furnished by the Wagner Electric Manufacturing Company, of St. Louis, Mo., and the arc lights, etc., were made by the General Incandescent Arc Light Company, of New York. The entire plant was designed from the drawings of Mr. M. P. Davis by T. Pringle & Sons, Montreal.

## French Engineering Studies in America.

At Pittsburg recently, M. Lazare Weiller and M. Maurice de Lagotellerie, in an interview, said they would recommend to the French Government that a school for educating French engineers be located in Pittsburg, and a school for political science be located in New York. The French visitors were selected by their government to carry out the ideas of M. Millerand to have French students educated in the United States. With Vicomte de Faramond, French Naval Attache at Washington, they spent several days with H. C. Frick. M. Weiller said that George Westinghouse, Jr., and H. C. Frick would be patrons of the Pittsburg school. He outlined the plan as follows:

"M. Millerand and other Frenchmen were much interested in the many Americans who came to Paris to study art and music. Knowing that the United States had forged ahead in the mechanical arts and political science, and desiring to perpetuate the Republican form of government in France, the idea presented itself of studying American institutions on the ground, as American art students do in France. Hence the Government will select the brightest students at the various academies, and will pay their expenses, allowing them a reasonable amount of spending money while here.

"They will take courses of from three to five years. For this they are expected to devote so many years to the service of the Government. Many wealthy and influential Americans will be patrons of the schools, among those in New York whom I have talked to on the project being J. Pierpont Morgan and Charles M. Schwab, who will aid the work. I have no doubt our recommendations will be carried out by the Government."

## The Economic Design and Management of Telephone Exchanges—VIII.

By Arthur V. Abbott, C. E.

UNDER certain distributions of stations, the location of the telephonic center will become partially indeterminate, or rather a number of sites may be found from any or all of which the mileage will be equal. Such a condition exists when there are no subscribers in the immediate vicinity of the center of the district. To illustrate, turn to Fig. 7. Here are 26 stations so distributed as to fall in 4 groups with no stations near the center of the territory. Evidently the condition of placing one-half the stations on each side of each axis is fulfilled by drawing the axis of $y$ anywhere between $y$ $y'$

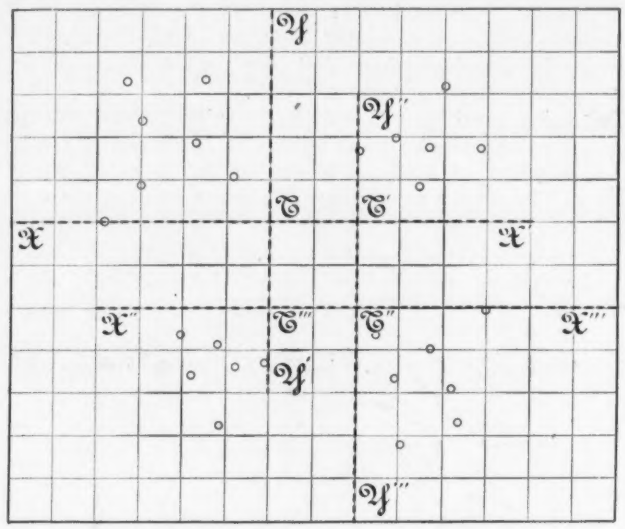


FIG. 7.—DETERMINATION OF TELEPHONIC CENTER.

and $y''$ $y'''$, and the axis of $x$ anywhere between $x$ $x$ and $x''$ $x'''$, and any location of the telephonic center within the rectangle $T$ $T'$ $T''$ $T'''$ is equally good. To provide this, suppose the line $y$ $y'$ to start from the position $y$ $y'$ and move toward $y''$ $y'''$. As there are 13 stations on each side of the line, every unit that the line moves to the right will add one unit to each of the lines to the stations on the left, and will

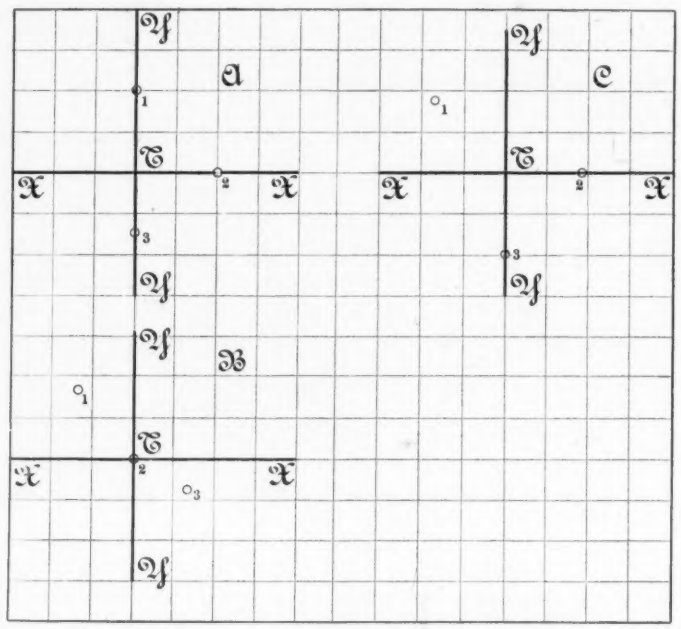


FIG. 8.—DETERMINATION OF TELEPHONIC CENTER.

subtract one unit from each of the lines to the stations on the right, as the number of stations is equal, equal amounts of mileage are added and subtracted, and the sum remains constant. Suppose, however, the moving axis in passage to the right *crosses* a station, *then* in the next unit that it moves, 14 mileage units will be *added*, and 12 units will be subtracted, hence there will be a net increase of two

units. The same reasoning may be applied to the $x$ axis. Hence the principle is established that there will be *no* change in mileage unless the moving axis *crosses* one or more stations. Thus if there are $n$ stations in any territory, there will be $\frac{n}{2}$ stations on each side of each axis. Suppose $a$ be the length of the average perpendicular distance from the axis to the $n$ stations, then the sum of the total perpendicular distances to the axis will be $\frac{a\,(n)}{2} + \frac{a\,(n)}{2}$. Now, suppose the

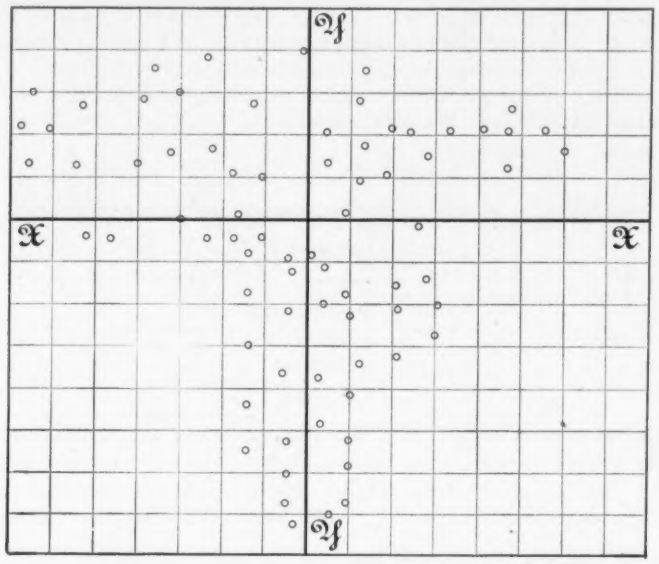


FIG. 9.—DETERMINATION OF TELEPHONIC CENTER.

axis to move and cross m stations, then there will be $\frac{n}{2} + m$ stations on one side of it, and $\frac{n}{2} - m$ on the other side. The mileage in this case will be $a\left(\frac{n}{2} + m\right) + a\left(\frac{n}{2} - m\right)$. Subtracting this latter quantity from the first, it is seen that the resulting mileage is greater by $2\,am$ than the former.

In Fig. 8 three examples are given of types of special cases that at first sight might seem to be exceptions to the rules as stated. At $a$ there are three stations, or groups of stations. If $x\ x$ be drawn to

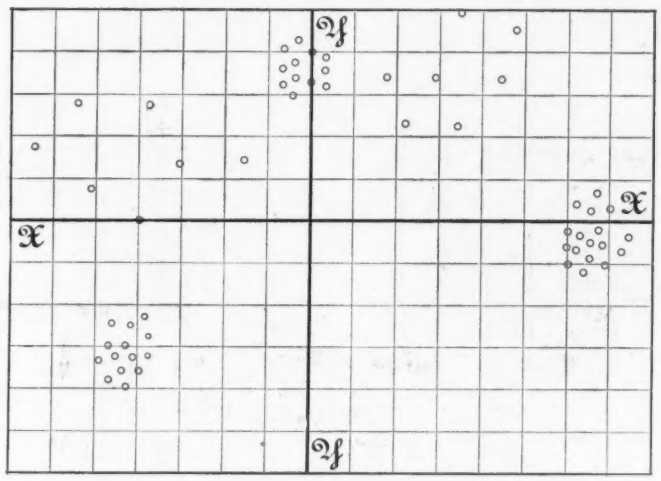


FIG. 10.—DETERMINATION OF TELEPHONIC CENTER.

place an equal number of stations on either side of it, it will pass through station 2, and if $y\ y$ be drawn perpendicularly to $x\ x$ and so placed as to give as nearly as possible an equal number of stations on each side of it, it will intersect 1 and 3. In this case the axes cut the three groups of stations. The total mileage is $T1 + T2\,T3$, and it is self-evident that if either axis be moved in either direction, this quantity will be increased. Turning to $B$, where the stations 1, 2 and 3 represent three isolated bunches of stations nearly in line with each other, if $x\ x$ and $y\ y$ be drawn to place equal numbers of stations on each side of them, and parallel with the section paper lines they will intersect at 2, leaving 1 and 3 in diagonally opposite quadrants. Here $T$ is at the telephonic center, and it is quite clear that any change in location thereof will augment mileage. In the distribution shown at $C$, if $x\ x$ be drawn to place an equal number of stations on each side of it, it will cut 2, and $y\ y$ under the same conditions will intersect 3, leaving 1 in the upper left-hand quadrant.

### IV. TYPES OF SUBSCRIBERS' DISTRIBUTION.

At first sight it might be supposed that the distribution of subscribers would be radically unlike in different towns or cities, but examination shows that the majority of cases, to say the least, will fall under six distinct and specific types of distribution. These six types may be denominated as follows:

1. *The Symmetrical System.*—In this type of distribution, the subscribers are spread over a territory approximately circular in contour, the greatest station density per unit of area being at the geometrical center of the district, and decreasing regularly radially in all directions. This is the simplest and probably the distribution most frequently met with, and is illustrated in Fig. 5. Examples of this type of distribution are so numerous that particular citation is superfluous, almost every small town or village affording an instance.

2. *The Isolated Group System.*—In this type there are two or more irregular groups of stations separated by territory telephonically sparsely populated. The station density is usually greatest at the center of each group, decreasing approximately radially toward the circumference of each. The usual form of this type of distribution is illustrated in Fig. 6, where there are four groups of stations, each entirely distinct from each other. The isolated group type of distribution is of very frequent occurrence. It is always met with where some natural obstacle, such as a river, dividing a town into two or more parts, and is usual where a city is made by the absorption of several small towns. The upper part of New York City and the environs of Boston and Philadelphia are good examples. In Fig. 10, an extreme case of the isolated group type is given, such as would be presented by the establishment of an exchange to serve three small towns, or a group of large factories. The rule for selecting the telephonic center is perfectly applicable, and even though it indicates a spot that is apparently a telephonic desert, a little consideration shows that neither axis can be moved without increasing the total mileage. The next most common type is the *Cruciform System*, shown in Fig. 9. This distribution is always found where there are two principal streets at right angles to each other, a very common urban feature. In this case the axes are almost certain to lie either on or very close to the chief thoroughfares, and the telephonic center may, with reasonable certainty, be located at the intersection of these streets without undertaking the task of map making or station plotting. The city of Chicago is an example of this type. In Fig. 11 the *Comet System* is exemplified. This type is of importance, as it is found in some of the largest cities, such as New York and Boston, though

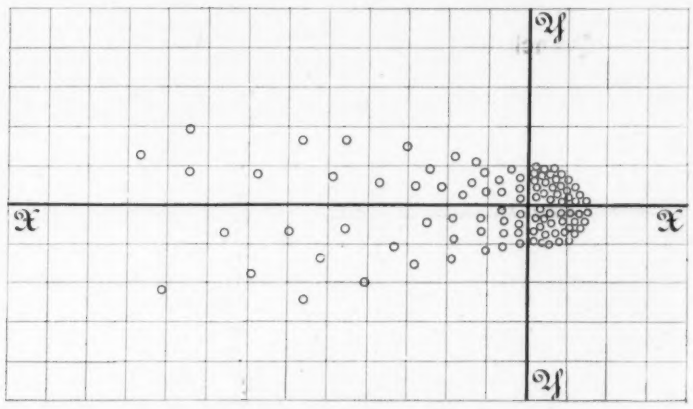


FIG. 11.—DETERMINATION OF TELEPHONIC CENTER.

it is of less frequent occurrence than those previously mentioned. It is usually the result of geographical conditions, such as the building of a city on a peninsula, that forces all business interests into a small space at the apex of the peninsula, but allows residences to distribute themselves over the adjacent country. The territory is more or less fan shaped, or wedge-shaped, with a group of stations of great density located at the small end of wedge; the density being maintained clear to the boundary lines, while toward the thick end, the station density very rapidly falls away, though the demand for telephones may extend many miles into the country.

*The Crescent System* is shown in Fig. 12, and in it, as its name in-

dicates, the stations are arranged roughly in a lune-shaped figure, the density being usually greatest along a line through the center of the crescent. This is really a modification of the cruciform system. It is found in the lake and river cities, such as Cleveland, Milwaukee, Cincinnati, New Orleans, etc. Lastly, in Fig. 13, the *Linear System* is shown. Here the stations are scattered over a rectangular area much larger than it is wide, with the greatest density approximately at the center of figure. This type is of quite rare occurrence.

In the selection of the central office site it is impossible to give too much care and consideration to station distribution. If a telephone plant is in existence, its directory may be obtained and the subscribers plotted by dots on a large scale map. Such a representation gives a

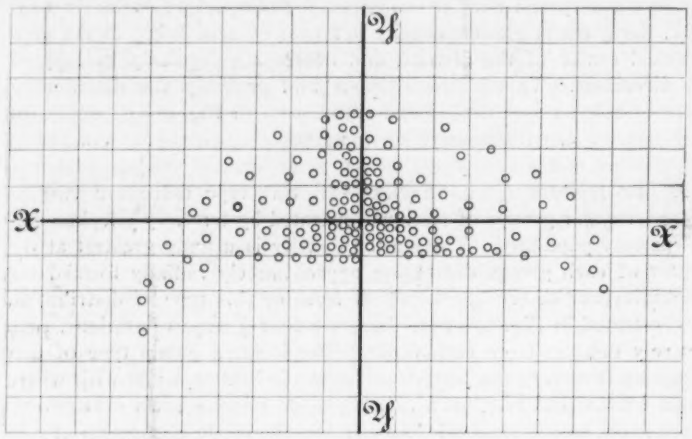



FIG. 12.—DETERMINATION OF TELEPHONIC CENTER.

good idea of the arrangement of existing telephonic population, but the telephone engineer, more than any other mortal, lives in the future, and in order to make a successful design a reasonably accurate forecast both of the number and location of subscribers for a decade or more in advance must be made. To this end it is well to obtain the opinions of a large number of the oldest and most experienced residents, as to the probable growth both in amount and direction of the various kinds of business represented. For, in all towns, trades are clannish, and sooner or later districts spring up, and leather, law, dry goods, brokers, etc., segregate away from each other, each forming little communities by themselves, and the opinion of conservative representatives of each class as to its probable future furnishes the only basis on which a telephonic prediction can be made. It is particularly necessary to consider the effect of transit facilities, such as railways, freight stations, elevated and electric roads, etc., on the probable relation of the business and residence districts, and in this

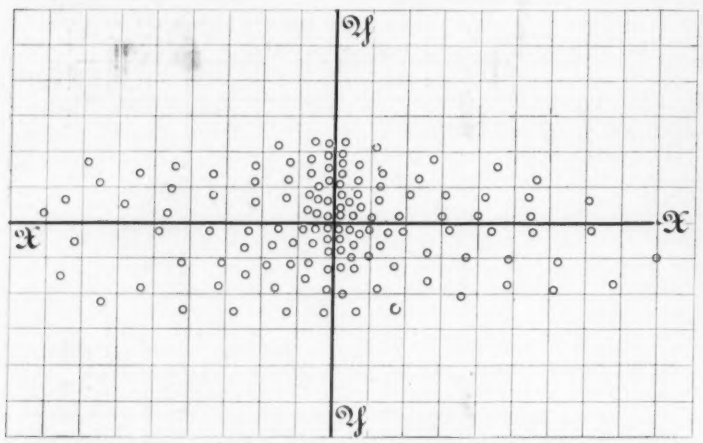



FIG. 13.—DETERMINATION OF TELEPHONIC CENTER.

connection the steadying or anchoring effects of the modern office building is particularly noticeable. After the widest and most thorough canvass yielding the most complete obtainable information as to the expected future trend of the city under consideration is obtained, an estimate of probable subscribers may be made. The tendency is always to make such an estimate too low, because, for many reasons, telephonic business is growing faster than even its most sanguine promoters expect, so a liberal allowance should be made for future growth. Then, this estimated distribution should be plotted on a large scale map, from which the telephonic center may be located. In addition, it is most useful and instructive to construct a relief model of density and distribution. This is done by cutting out a board to scale, say, four inches equal one mile, representing the area under consideration. A number of strips of wood one-half an inch square, thus representing an area of 1-64 of a square mile, are prepared, and these strips cut of various lengths to represent the number of stations on each of the areas they represent. For example, suppose in the least dense portion 10 stations are estimated per block and in the densest portion 500 per block. Let the vertical scale be 100 subscribers per inch, then a piece of strip 1-10 of an inch thick will represent areas of minimum density, and a piece 5 inches will stand for the spots of greatest density. By thus cutting a piece of wood for each city block of such a length as to represent the expected number of subscribers on that block, and fastening it on the board in its proper place, a relief map of density and distribution is obtained that conveys the most vivid possible idea of the expected telephonic population.

## The Debt of Electrical Engineering to C. E. L. Brown—XI.

By B. A. Behrend.

(*Concluded.*)

### TRANSFORMERS.

We have already called attention to some transformers designed ten years ago by Mr. Brown. We now give in Fig. 70 a photograph of a modern oil filled, water-cooled transformer, and in Fig. 71 we give a drawing of it. This transformer is

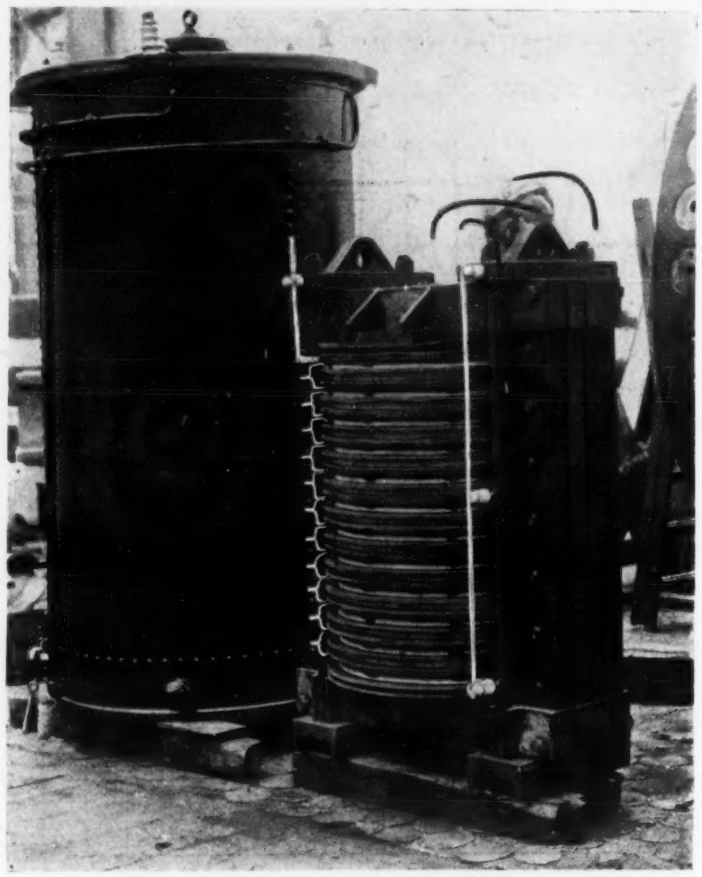


FIG. 70.—250-KW SINGLE-PHASE TRANSFORMER.

for an output of 250 kw at 40 cycles. The losses at full load are:

| | Watts. |
|---|---|
| Core loss | 3385 |
| Copper loss primary | 1263 |
| Copper loss secondary | 1322 |
| Total | 5970 |

The efficiency at full load is, therefore, 97.6 per cent. The weight of the complete transformer with oil is 11,700 lbs., the oil weighing

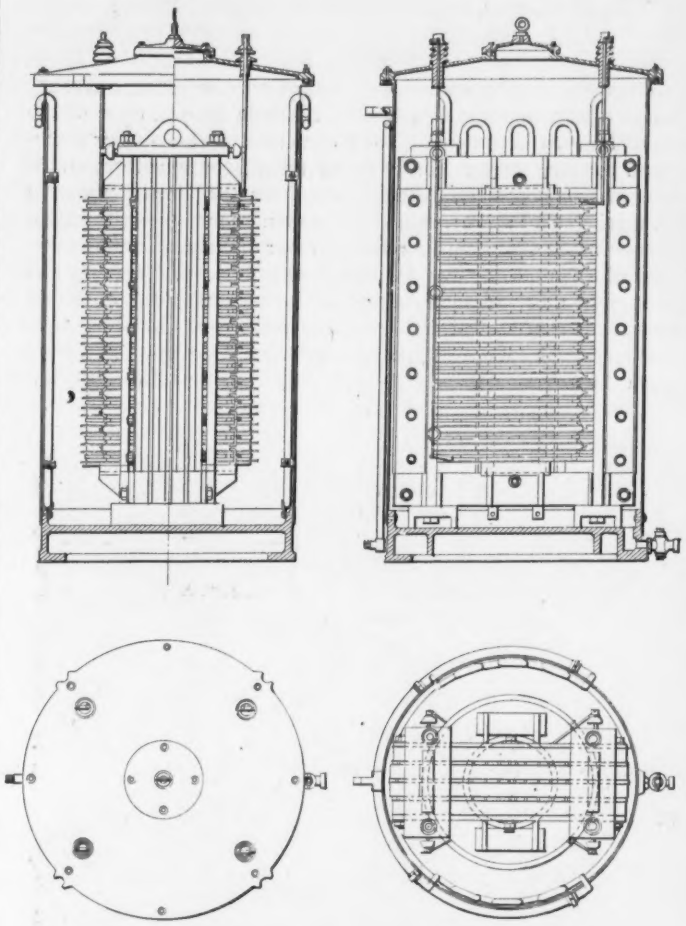


FIG. 71.—250-KW SINGLE-PHASE TRANSFORMER.

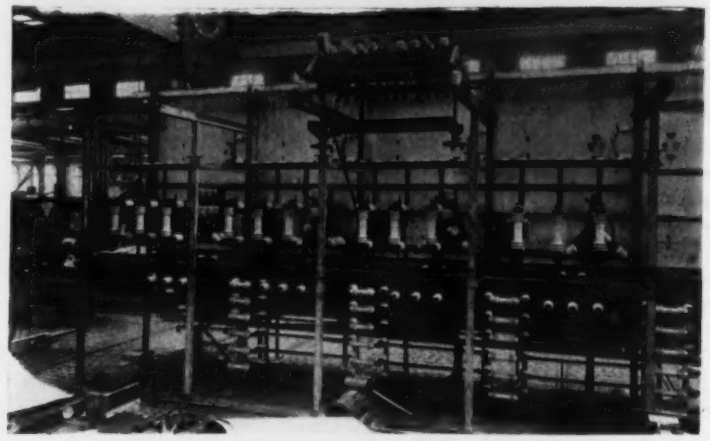


FIG. 76.—PADERNO SWITCHBOARD.

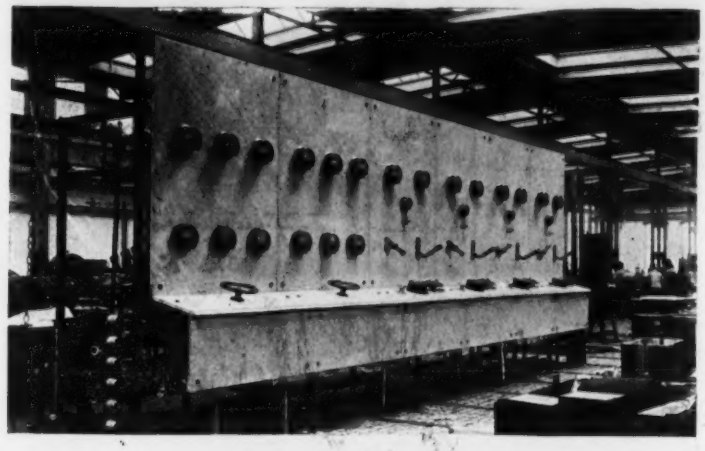


FIG. 77.—PADERNO SWITCHBOARD.

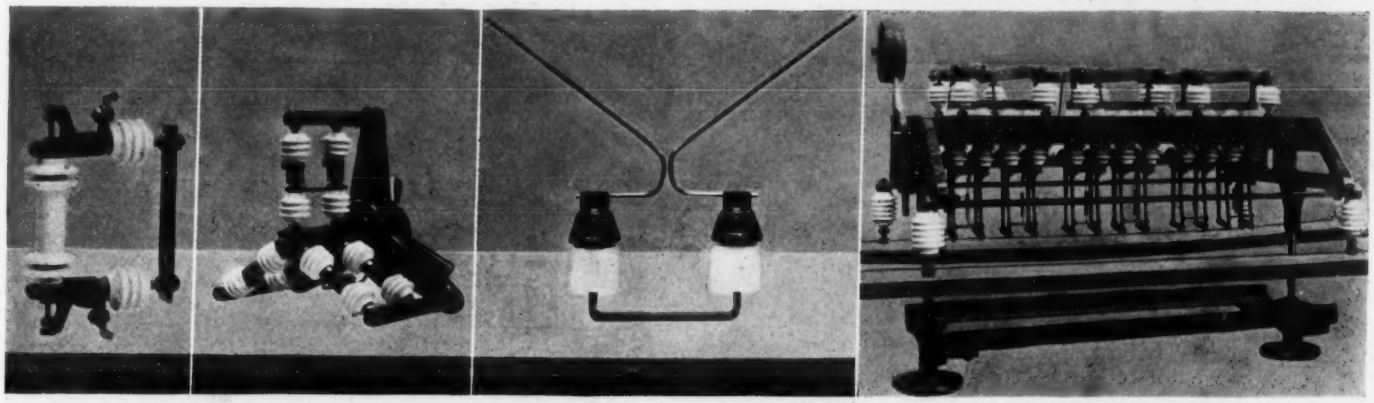


FIG. 72.—HIGH-TENSION FUSE. FIG. 73.—DOUBLE-BREAK SWITCH. FIG. 74.—LIGHTNING ARRESTER. FIG. 75.—OIL SWITCH.

FIG. 78.—WORKS IN BADEN, SWITZERLAND.

1800 lbs. To increase the radiating surfaces of the transformer cases, Mr. Brown introduced ribs, and early in 1891 he proposed for Lyons the cooling of large oil-filled transformers by means of water circulation.

SWITCHES AND SWITCHBOARDS.

Switches, fuses and switchboards for high-tension work had to be developed, and Mr. Brown's fertility in designing shows itself here to good advantage. Fig. 72 shows an enclosed high-tension fuse used as disconnector. Fig. 73 shows a three-phase double-break switch. Fig. 74 shows the horn lightning arrester, which goes by the name of Siemens lightning arrester, though used by Brown almost two years before the Siemens patent was applied for. Fig. 75 shows the large Paderno oil switch. The arc is broken under oil by the small switches, with exchangeable blades, and after it is broken the main switch is opened. Figs. 76 and 77 show the Paderno switch-

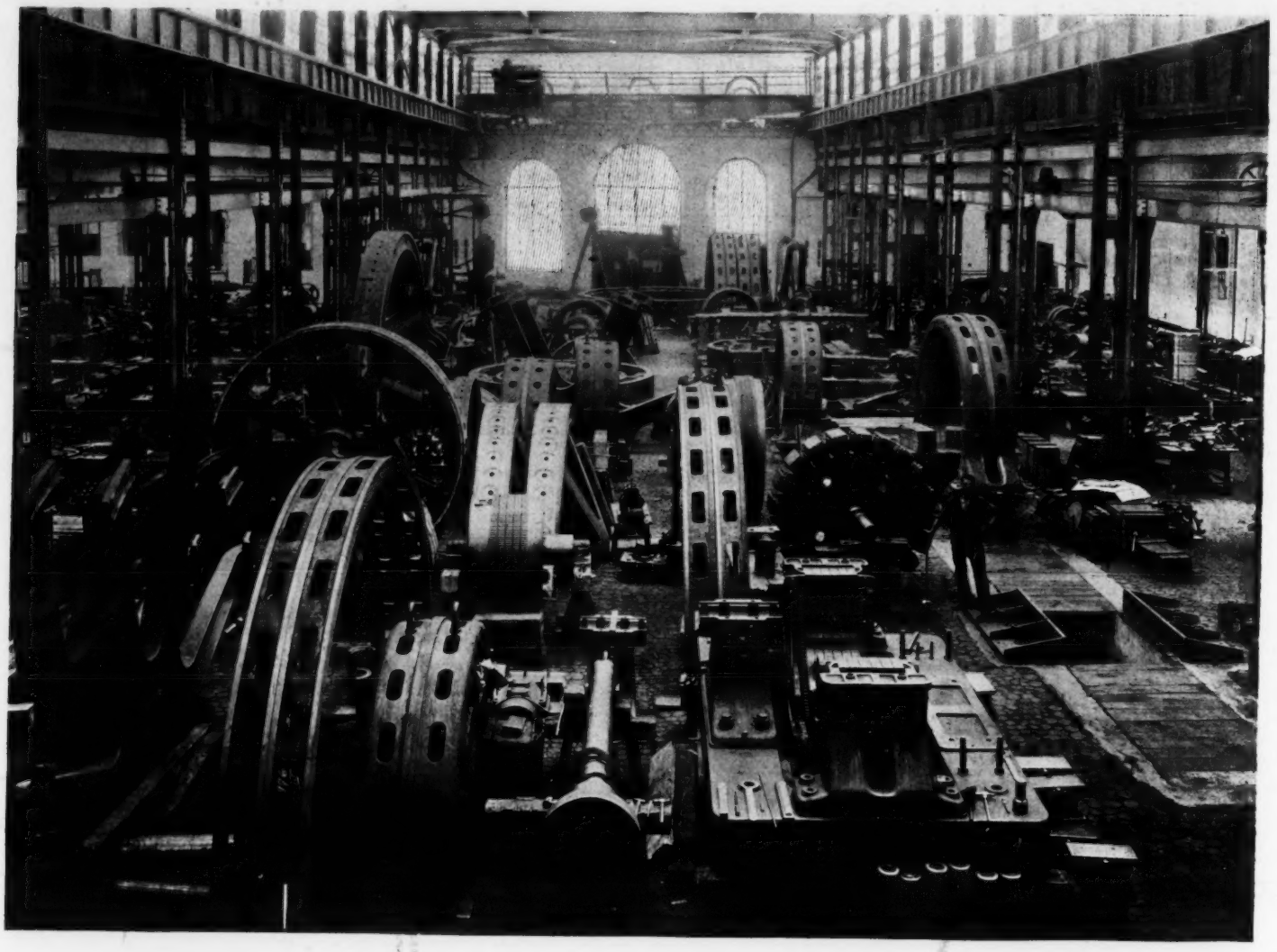


FIG. 79.—INTERIOR OF ONE OF THE SHOPS IN BADEN.

board, with the iron framework mounted on insulators. The main switch is clearly visible.

CONCLUSION.

We have more or less briefly outlined the work of C. E. L. Brown and its influence on electrical engineering. From a small beginning a huge industry has arisen that has entirely transformed the aspect of the mechanical industries, and among the pioneers in this field the name of Brown runs as little risk of oblivion as those of Siemens and Westinghouse, of Gramme and of Hopkinson. He gave a great stimulus to electrical engineering, and his work has found the recognition which it deserves. In Switzerland he has created a powerful industry, and his own works are among the largest and best in Europe. In fact, for an electrical engineer of any nationality, one of the most interesting parts of a trip to Switzerland is that which includes his visit to the splendid shops which dominate the beautiful landscape at Baden and which illustrate so admirably the genius of the little Republic in all that relates to modern engineering.

## The Foreign Commerce of the United States.

The Department of State has just issued an interesting summary of American foreign commerce by Mr. Frederic Emory, chief of the Bureau of Foreign Commerce. The commercial reports of our diplomatic and consular officers for last year record continued growth in the sales of many lines of manufactures from the United States in foreign markets and an increase of the general concern felt throughout Europe as to the possible results of our industrial competition. Although the figures for our exports compiled by the Treasury Department show a considerable falling off in the total value of manufactured goods sent abroad, it is said that there seems to be a steady and uninterrupted spread in the popularity of what may be termed American "novelties" all over Europe. By the word "novelties" is meant not only labor-saving implements and machinery, but a great variety of articles of merchandise, all of which possess distinguishing points of excellence and relative cheapness, which commend them to purchasers in Europe in preference to similar articles of home manufacture. In other words, while the aggregate of our exports of manufactured goods has shrunk in value, the variety of our sales in Europe is being extended and the territory upon which they are encroaching is being steadily enlarged.

The falling off in American exports is attributed, not to the goods being in less favor, but rather to business depression in Europe, which has limited the purchasing power. The elimination of Hawaii and Porto Rico from the list of countries to which we export is also a factor. The Treasury figures show that during the calendar year there was a falling off of $12,565,194, compared with the previous year, manufactures having fallen off $46,262,912, offset by a gain in agricultural exports of $35,591,077. It does not seem, however, that there is any decline in quantities.

Mr. Emory says it is evident that the American invasion of Europe

has ceased for the time being to be of that sweeping character that distinguished it at first as an economic phenomenon. He recalls what was said in the review a year ago of the chance of more strenuous European competition, the use of new processes and our own models of machinery, but he says that Europe has not made any sensible progress in that direction. As to restrictive legislation, pending measures in Europe might be abandoned, according to the review, if the United States modified its tariff policy and permitted more imports from Europe. As factors making in our favor, the review points to alleged obstruction by British labor, which increases our trade opportunities, to the combination of labor and capital here, as shown at the recent conference of employers and employes in New York, and to the fact that our competitive energy is so far but partly developed. On the whole, Mr. Emory finds that the United States has hardly more than entered upon a novitiate in fitting itself for international competition, and he notes with encouragement the growth of popular interest in the value of foreign trade and our well-directed efforts for expansion.

Mr. Emory says: The relation of the economic forces of the United States to those of Europe may be taken as the surest index to the probable future of our trade with the rest of the world; for it must be evident that, if we can continue to compete with European industries in their home markets, we shall have but little to fear from their rivalry in the neutral or undeveloped markets, where we would meet them on an equal footing. Even in Canada, notwithstanding a preferential tariff of 33 1-3 per cent in favor of British imports, we continue, says Consul-General Bittinger, of Montreal, to enjoy "more of Canadian custom than the rest of the world put together," and many classes of goods which some years ago were bought in Great Britain are now more cheaply and more conveniently purchased in the United States. Last year, our sales to Canada amounted to more than $110,000,000, while those of Great Britain were only about $43,000,000. In Mexico, Consul-General Barlow reports the purchases from the United States show a large increase—over $4,000,000, or 11.8 per cent—while those from every other country exporting largely to Mexico, except Germany, show a large decrease. The German gain was only about $411,000, or 5.8 per cent. In the reports from Central America and South America, there are gratifying indications of substantial growth in the sales of our goods, and we are steadily widening the variety of our exports to Africa, Asia, Australasia—in other words, to every part of the world.

## Manufacture of Soluble Barium Compounds in the Electric Furnace.

Mr. Charles B. Jacobs read a paper Feb. 21 before the Society of Chemical Industry, in which he described the manufacture of soluble barium compounds from barytes in the electric furnace. The electrical process is based upon a discovery which brought to light a new chemical reaction, which takes place beyond the range of temperature attainable in combustion furnaces. The furnace charge is made up of a mixture of ground barytes and coke in the proportions of four molecular equivalents of barium sulphate to four molecular equivalents of carbon. When this mixture is heated there is an immediate reaction between the carbon and the barium sulphate, in which one part in every four of the latter is reduced to barium sulphide and a mixture is produced containing approximately three molecular equivalents of barium sulphate and one molecular equivalent of barium sulphide. Under the high temperature of the electric furnace these react such that not more than 2 or 3 per cent of unconverted sulphate is left in the charge, the other product being barium hydrate and a small amount of sulphide.

The furnaces used in the process are a new type of continuous electric furnaces of the tapping variety. They are tapped periodically as in the case of iron blast furnaces, and have a maximum power consumption of 500 kw and a maximum output of 8 tons of furnace product every 24 hours. The product tapped from the furnace is dissolved in hot water, and the insoluble impurities filtered off, these latter consisting of a saturated solution of barium hydrate containing a small amount of barium sulphydrate. The barium hydrate is crystalled out by cooling, and the sulphydrate remaining is carbonated or converted into some of the acid salts of barium. The barium hydrate crystals are freed from the last traces of sulphydrate liquor by washing with a spray of cold water, and after drying are melted and the fused mass poured into thin iron drums, where it solidifies on cooling into a solid shape of crystallized hydrate weighing about 500 lbs. and containing less than 1 per cent of impurities.

The largest consumption of barium hydrate is in the sugar industry for the recovery of sugar remaining uncrystallized in the molasses, replacing lime for this purpose, owing to its much greater efficiency and the low price at which the hydrate can be produced by the present process. It is also applicable to the treatment of the residue of plantation sugar houses and certain low grades of molasses which, while rich in sucrose, cannot otherwise be crystallized, and are unfit for domestic use. Another use is in the purification of water for steam boilers, replacing sodium for this purpose, as it precipitates the scale-forming impurities and does not, as in the case of lyes, induce priming. Another use is in tanning. Hides immersed in dilute solution of hydrate show that the hair is loosened at the roots so that the hides can be worked in from three to five hours after being put into the vats, and longer immersion does not appear to injure them.

One of the important fields for cheap barium hydrate is in the manufacture of pigments. Its strong affinity for the sulphuric acid of soluble sulphates, and the fact that it interchanges its hydroxyl, precipitating in many cases insoluble hydrates simultaneously with barium sulphate in intimate molecular mixture, makes it especially adapted for these purposes. A permanent white pigment may thus be produced which combines the valuable covering properties of white lead and the staple white color of zinc white.

The paper states that so rapidly has the demand for barium hydrate increased, that after less than a year's commercial operation it has been found necessary to increase the capacity of the plant to a basis of 60 tons of hydrate per day. This demand has been such that no attention has been given to the great capabilities of the present electrical process for the economical production of other compounds of barium.

## Kettle River Power Development.

The development of 3000 hp on the Kettle River, at Cascade, British Columbia, about 15 miles east of Grand Forks, will soon be an accomplished fact. The work has been in progress for nearly two years. Electrical power will be conveyed by wire to the various mining camps, thus reducing the cost of mining development. Several of the smelters are also figuring on utilizing the same energy. Next spring will see the plant in full operation. The Cascade power is controlled by the London & British Columbia Gold Fields Company, of London, England, and the late J. Roderick Murray, who was killed in the Murray Hill Hotel, New York, by the recent dynamite explosion, was general manager, with headquarters at Nelson, B. C.

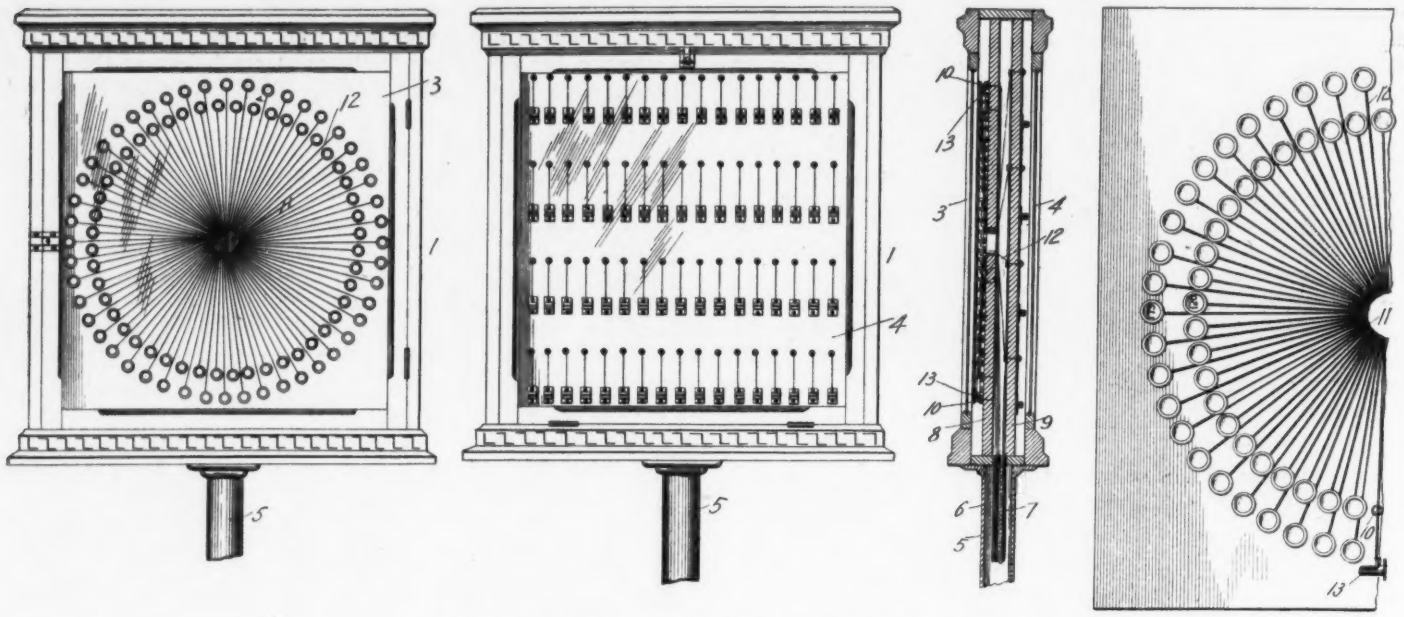
At Cascade, the Kettle River rushes through a rocky gorge for a distance of half a mile, and has a natural fall of 121 ft. A dam, 400 ft. long and 50 ft. high, has been constructed at the head of this gorge, which raises the water 36 ft. above the natural level, thus giving a working head of 156 ft. at low water. The dam, which is 40 ft. thick at the base and 24 ft. thick at the top, is constructed of timber crib work filled with rock. About 1000 yards of rock are required to fill the crib. The dam is on a solid rock bed throughout, and the foundation timbers are solidly bolted to the rock. The permanent water level will be 10 ft. below the top of this dam. Provision has been made to control the water level, during the periods of high water, by a series of sluiceways, 12 in number, which can be opened to a depth of 12 ft. below the normal level, giving an area of about 2000 sq. ft. of waterway through which to pass the flood water. These sluiceways are closed at low water by means of stop logs, 12 inches square, dropped one on top of the other, in a groove provided for their reception, thus maintaining the same head at all stages of water.

From the dam the water is to be conveyed to the power house, first by an open cut 225 ft. long, thence through a tunnel in the solid rock a distance of 410 ft., the tunnel being 12 by 14 ft., thence by an open cut in the rocks for a distance of 500 ft. From this point, where a concrete bulkhead will be built, the water will be conveyed through a circular flume, 12 ft. in diameter, to the power house. The power house is nearing completion. It is a fireproof structure of stone and brick, and is situated at the foot of the falls, 2000 ft. from the dam. Electrical machinery of the most approved pattern, together with six turbine wheels of the horizontal type, is now being manufactured especially for this plant. At the outset, the horse-power developed will be 3000, but later it is expected that a maximum of 9000 hp will be reached. A right of way has been cleared from Cascade to Phœnix, via Grand Forks, a distance of 21 miles. Two separate duplicate lines are being constructed. Poles have been erected, and a heavy copper wire will be strung for the transmission of power.

## New Telephone Patents.

The issue of Feb. 18 is a maiden issue as regards telephone patents proper, telephony being represented only by a patent granted to Mr. A. Bishop Chance, of Centralia, Miss., on a transfer board for telephone and telegraph circuits. Mr. Chance says that "in the ordinary transfer board the transfer of any one wire from one connection to another is made of bridging over from one connection to another with a piece of wire. The object of the present invention is to obviate this crude and objectionable practice and to provide means whereby the transfer from one connection to another may be easily and speedily effected."

The means provided by Mr. Chance are a spring-jack or socket as the terminal of one wire and a plug as the terminal of the other. Where wires are handled on a small scale this is all right enough, but what there is crude or objectionable in the modern telephone distributing board with its soldered cross-connecting wires it is difficult to see. It is the general practice to solder distributing and cross-connecting wire connections wherever possible and a soldered connection would seem to be less crude and objectionable than a plug and socket connection. Moreover, the transfer board designed by Mr. Chance is not adapted to handle large numbers of wires, and would be relatively expensive. Further, it is difficult to see where the patentability of the device comes in. In general design it is an exact copy of the old French *rosace*, and plug and jack connections for changing circuits are used in every large telegraph office in the country. The drawings illustrate the invention quite clearly, Fig. 1 being a front view, Fig. 2 a back view, showing the fuse-board, Fig. 3 a cross-section, showing the two cables 6 and 7 to be cross connected, and Fig. 4 an enlargement of part of Fig. 1. The line wires are attached to the jacks or sockets 10 set into the face of the board 8, and the transfer wires 12, extending from the fuse-borad terminate in spring plugs or pins 13 for engagement in sockets 10. Each jack and plug is suitably numbered or lettered, and by putting any plug in any jack any two wires may be connected. As all the free wires 12 radiate from a common center changes may be made easily and neatly.




FIGS. 1, 2, 3 AND 4.—CHANCE'S TRANSFER BOARD.

## Electricity for Main Swiss Railways.

Mr. Henry H. Morgan, United States Consul at Aaron, Switzerland, writes to the State Department as follows: Some days ago the representatives of the five largest electrical engineering companies of Switzerland held a meeting at Olten, at which the question of replacing steam with electrical power on the Swiss railway system was discussed. The representatives of a firm which makes a specialty of the construction of turbines (having lately received a large order to provide turbines for Niagara Falls) proved by scientific demonstration that the power which could be derived from Swiss waterfalls would be sufficient to provide enough electrical force for the entire railway system of the country.

It was decided to follow the example of Germany and constitute a society, composed of all the companies interested, which will furnish the funds necessary to investigate the subject.

The *Aargauische Nachrichten*, commenting on the project, says: The Swiss Government, which will, within a few years, be the owner of all the great Swiss railway lines, is aware of the importance of the plan, and competent officials have expressed the opinion that the authorities will not fail to largely subsidize the intended experiments. The question of rendering Switzerland more and more independent of foreign coal by transforming her water-power into electricity is of vital importance for the country.

The turbine firm referred to by Mr. Morgan is Escher, Wyss & Co., of Zurich. Among the electrical concerns are Brown, Boveri & Co. and the Oerlikon Works.

## The Gilbert Club "De Magnete."

With regard to our recent announcement of the completion of the Gilbert Club's translation of Dr. W. Gilbert's "On the Magnet" ("De Magnete"), we have now heard further from Professor S. P. Thompson in regard to this interesting subject. He says: "The actual cost of simple printing, binding and postage exceeds £1 per copy; and if we include the cost of circulars and incidental expenses of the formation of the club, it runs to over £1.2 per copy. To keep faith with our original subscribers and members, we had to issue the book in half holland bindings at £1.1.6, so that there is an actual loss on each copy. The rather more expensive copies bound in limp vellum have cost us about £1.10.6 to £1.12 each, and as we supply these to subscribers who prefer that style at £1.12.6, that is also practically at cost price. The few remaining copies will be sold to non-members of the Gilbert Club at £2 for half holland copies and £2.10 for vellum copies (i. e., $10 and $12.50)."

It will be seen from the above that copies for American purchasers will cost a little more than our first estimate. As soon as possible we shall announce the exact cost, laid down in this country, and meantime would request that any of our readers who desire to secure spare copies enter their names at once, as it is evident very few will be available. The original subscribers and members of the Gilbert Club in this country were Dr. Park Benjamin, Professor Alex Graham Bell, C. L. Clarke, R. N. Dyer, T. A. Edison, T. D. Lockwood, T. C. Martin, Professor A. M. Mayer (deceased), Dr. H. Morton, Dr. M. F O'Reilly (Brother Potomian), F. L. Pope (deceased), A. L. Rotch, Profesor Elihu Thomson, Nikola Tesla, Joseph Wetzler, Dr. H. C. Bolton.

## An Ohio Telephone Association.

Representatives of the various independent telephone companies of Preble, Darke, and Montgomery counties, Ohio, met at Lewisburg, Ohio, Feb. 12, for the purpose of forming an association for mutual benefit. The chief object of the organization is for the establishment of a uniform schedule of tolls and to bring about closer relations between the various companies. The organization was perfected by the election of Colonel Rush, of Greenville, president; D. E. Horn, Lewisburg, vice-president, and C. E. Brooke, Jr., of Eaton, treasurer. A committee composed of Judge Elam Fisher, of Eaton; J. S. Stewart, of Gratis, and Fred Emerick, of West Milton, was appointed to outline a plan for the regulation of tolls. The committee is to report at a later meeting to be held in Greenville. The members of the association are the Eaton Telephone Company, the Southern Ohio Telephone Company, the Greenville Telephone Company, the Camden Telephone Company, the Winchester Telephone Company, the Lewisburg Telephone Company, the West Union Telephone Company, the West Milton Telephone Company, the Phillipsburg Telephone Company, the Brookville Telephone Company, the West Manchester Telephone Company, the Gratis Telephone Company and the Arcanum Telephone Company.

## A Society Badge.

The New York Electrical Society, in order to fittingly celebrate its coming of age, is adopting a badge this year, and is now struggling with the problem. Two or three good designs have been worked up and submitted. The triangular ones, though good, are hackneyed, and have, moreover, the objection that the corners always catch in the material to which they are pinned. One design shown at the meeting on Feb. 13 became popular at once, and received twice as many votes as the triangular type. It is circular in form, like a compass, and has the initials of the Society arranged to the four cardinal points, the Y answering for the W. The ground is dark green, but President Williams has suggested making this of amber, or in yellow tint, with red or dark blue letters and border, etc. It seems probable that this idea will be carried out.

## Telephone Girls Must Tell.

Because the telephone girls in the Boston exchange refused to repeat messages they had heard over the wires, the Post Office Department is endeavoring to have passed a law imposing a penalty of $500 for any employe of a telephone or telegraph company who neglects or wilfully refuses to deliver any message to any person other than the one for whom it is intended. The same penalty is also to be imposed on any employe who fails to inform the authorities of any attempt to use the telephone or telegraph for unlawful purposes. Those responsible for this bill are Postmaster Hibbard, of Boston; Inspector Evans and Inspector Swift, of New York, who have had experience with the telephone companies recently in trying to locate "green goods" men and others, who have been using up-to-date methods in their businesses. A prominent firm of brokers lost bonds worth thousands of dollars recently by doing business over the telephone with an unknown person, and cases of this sort have been so frequent of late that the detectives are not very well disposed toward telephone girls in general. The bill is meeting with considerable opposition.

## More Long Distance Transmission in Southern California

It would seem that the engineers and capitalists responsible for having made Southern California, in the neighborhood of Los Angeles, a past leader in long-distance high-voltage transmission work, are determined not to let that reputation get away from them. As noted before in these columns, the Edison Electric Company, of Los Angeles, which has transmission and distributing systems covering all the principal valleys south of the Sierra Madre Mountains for the 80 miles between Redlands and Los Angeles, is now developing a water power in the Kern River Cañon north of the Sierra Madre Mountains. As W. H. Workman, Jr., assistant to the president, modestly puts it: "The main line connecting the Kern River stations with the remainder of the system will not greatly exceed 130 miles."

Besides the Kern River additions to this immense network of high-tension lines contracts have been let for four 750-kw revolving field Bullock generators to go in Station No. 3 on Mill Creek to be run by waterwheels under 1900-ft. head, the highest yet employed in Southern California. This is but a few miles from the company's Santa Ana Cañon plant which now transmits to Los Angeles over an 83-mile line at 33,000 volts.

# CURRENT NEWS AND NOTES.

*CONFEDERATION OF AUTOMOBILE CLUBS.*—The Automobile Club of America, the Philadelphia Automobile Club, the Long Island Automobile Club, the Rhode Island Automobile Club and the Chicago Automobile Club propose to organize a federation of such bodies, and have called a convention at the Chicago club's headquarters at the Coliseum, for March 3 and 4. The contemplated premises for organization are, briefly, that all regularly constituted and active automobile clubs of acceptable repute be eligible to membership on an equitable basis of representation in all deliberative matters within the purview of the Federation; conventions to be held annually in the East and West, alternately; an executive and other standing committees to be instituted. It is proposed that the executive body meet once each calendar month; the practical objects which it is believed may be attained by any club corporation are: Enactments of liberal laws regulating the use of automobiles on public highways; protection of the legal rights of users of motor vehicles; improvements of public highways; development and introduction of the automobile; equitable regulation of automobile racing and trials of endurance and efficiency; a medium for counsel and interchange of information, ideas and suggestions tending to the development and advancement of the art.

*CARNEGIE INSTITUTION PLANS.*—At the banquet of Johns Hopkins Alumni and guests in Baltimore last week, President Gilman outlined his plans for the Carnegie Institution to an audience of 600. No such complete statement has previously been made. It turned out; quite as it had been foreshadowed, that President Gilman intends to build up a permanent advisory staff of specialists in all branches of science. He means also to foster science in the broadest sense of the word. He mentioned economics alone of the historical sciences, but the numerous historians, philologists, and philosophers present assumed that their favorite studies would not be neglected. For a considerable period, the Carnegie Institution will confine its work to examining the present condition of American scholarship. The publications in the various fields will be examined by experts, who will finally present exhaustive reports, on the present condition and needs of every branch of learning in America, on the quality and promise of the workers in their several fields. These reports will in the sum constitute a kind of survey of the present state of learning in America. Upon this sound basis assistance will be granted to productive scholars, for the institution, all rumors to the contrary notwithstanding, will confine itself strictly to the encouragement of scientific research.

*HERTZIAN WAVES FOR CONTROLLING TORPEDOES.*—A patent issued Feb. 18 to John Gardner, of Fleetwood, England, describes an apparatus for controlling actions at a distance by means of Hertzian waves. The inventor states that the apparatus may be employed to control distant signal stations, automobiles, dirigible balloons, light stations, etc., but the specifications refer to its use only in connection with torpedo or submarine vessels. Briefly, the receiving apparatus consists of a shaft carrying a small centrifugal governor, motion being given to the shaft by an electromagnetic ratchet mechanism, the circuit of which is controlled by a coherer. At different speeds of the shaft the governor makes different contacts, by means of which the propeller motors of the boat are controlled or the torpedo charge fired. At the transmitting station a mechanical device is employed whereby the induction coil circuit can be closed for definite periods, and with greater or less intervals between the periods. At a normal rate of closure the governor shaft at the receiver is turned at such a speed that a lever on the governor muff will make a contact such that both propelling motors will operate. With a less number of periods a different contact will be made such that only the port motor will operate, and with a greater number the starboard motor only will operate. Finally, at the highest rate of speed a contact will be made whereby the charge of the torpedo will be fired.

*MORE PACIFIC CABLES.*—The *London Daily Telegraph* says it understands that Canada has definitely decided to lay a cable to Great Britain, independent of the existing Atlantic lines, and also a Pacific cable. This hardly seems credible. If it is true, the competition will keep all the Pacific cables on a starvation basis for many years to come.

*LONDON UNDERGROUND.*—A recent cable message from London says: Robert William Perks, M. P., chairman of the Metropolitan District Railway, presiding at a meeting of the shareholders of the road, said he regretted to present a report which was the worst in 35 years. He attributed the loss of £53,000 in the last six months to the fact that the road was not electrified, and added that he hoped the worst was past. Mr. Perks objected to Charles T. Yerkes and other Americans interested being termed "foreign speculators," and also to the assertion that the road was dominated by an American syndicate.

*THE CAR "IDLER."*—Work has been completed at the Wilmington, Del., shops of the Pullman Palace Car Company on the car "Idler," which will be used by Prince Henry of Prussia and his suite during their tour of this country. The "Idler" is a combination observation and stateroom sleeper, and is one of the handsomest cars ever fitted out in the Wilmington shops. The interior decorations are of bronze and mahogany, and all the rooms are lighted by electricity. The upholstery is of blue plush and brown tapestry, and the curtains are of brown silk. Electric fans will cool the air in the different compartments.

*PACIFIC CABLE LAYING.*—It does not seem to be generally known that cable laying is already in progress in the Southern Pacific. Last January the Telegraph Construction & Maintenance Company, of England, dispatched two ships. The "Scotia" had on board 1700 knots of cable to be laid between Glenelg and Fremantle, Australia. The "Anglia" had on board 2500 knots for the southern portion of the Colonial Pacific Cable. Her connections are for three sections, Brisbane, Queensland to Norfolk Island; Auckland, N. Z., to Norfolk Island, and Fiji to Norfolk Island. The company's new steamer will take out the whole of the Vancouver-Fanning section of 3500 knots, and should be available for a similar load this time next year should her services be in requisition.

*MERCURY CATHODE CELL.*—A cell for the electrolysis of brine for the production of chlorine and caustic soda, patented Feb. 18 to George M. Wilson, of Sault Ste. Marie, Canada, is a modification of the device patented in 1894 to Sinding-Larsen. A mercury cathode is circulated beneath the anodes by means of a horizontally mounted paddle-wheel, passing thence through traps into the presence of water and, when denuded of its amalgam, returning by lateral passages to the wheel. Two features of the cell are adopted directly from recent devices described by Rhodin. These are the carbon plate covers serving both to support the anodes and to convey the current to them, and the means whereby fresh electrolyte is continuously introduced into the field of most rapid decomposition.

*PURIFICATION OF SUGAR SOLUTIONS.*—MM. Lavollay and Bourgoin, of Paris, have recently patented a method for the purification of crude sugar juices, consisting in outline in electrolyzing them between zinc plates while maintaining in suspension a pulverized mixture of calcium fluoride and manganate. After a few minutes' treatment barium carbonate is stirred in to complete the decolorization. An effective defacation is said to be obtained, although the character of the action is not clear, especially since the effect seems to be independent of the material of the electrodes, and since both salts are substantially insoluble in the liquid. It is possible that the unstable manganate acts as a carrier of the oxygen derived from the decomposition of water, accentuating its bleaching action. The inventors have heretofore patented the application of the manganate alone, in presence of the current, to the purification of various liquors and to the rectification of spirits.

*WIRELESS TELEGRAPHY.*—In connection with the interesting article by Mr. Emerson in our issue of Feb. 15 on Edison's wireless train telegraphy some years ago, Mr. W. J. Hammer, who was connected with the experiments and practical work at that time, has called our attention to the broad United States patent granted Mr. Edison on the subject in 1891 upon an application filed in 1885. There are five broad claims for the use of condensing metallic surfaces and static effects so as to signal at considerable distances, and the drawings show balloons, sails of ships, etc., employed for the purpose. Mr. Hammer reports that on one of the train trips on Long Island Mr. Seligman, the banker, bought and sold stocks by means of messages thus exchanged through the air. Mr. Hammer sent a message to himself at Newark, N. J., while the train was running 40 miles an hour, and the nearest telegraph wires were between 300 and 400 ft. from the condenser roof of the car.

*THE TELEPHONE IN JAPAN.*—Some interesting facts about the telephone service in Japan have recently been published by the London *Electrician*. The Japanese telephone service is regulated by the Department of Communications, which has charge of all affairs connected with the postal, telegraph, telephone, railway, lighthouse and navigation services, and regulates all matters affecting electric lighting and power. At Kobe there is a telephone exchange which, at the end of October last, had 1176 subscribers. There is a telephone trunk service available between Kobe and Tokyo, a distance of 377 miles; Kobe and Yokohama, 359 miles; Kobe and Nagoya, 161 miles, and between Kobe and Osaka and Kioto, which are comparatively short distances The charge made for trunk communications appears to be about 20 cents (Japanese money) per 50 miles for five minutes' conversation. The public service within the city of Kobe is 5,400 cents per annum. All the lines, instruments and fittings are owned by the Government.

*PARIS UNDERGROUND.*—The Paris Municipal Council has formally adopted in its main lines the recommendation to grant a concession for a new "tube" railway running between Montmartre at the north end of the city, and Montparnasse at the south end. The company offers to pay to the municipality a tax or due of 1 centime per passenger carried over its line up to 30,000,000 passengers, and 2 centimes per passenger for any number over 30,000,000. This is for second-class passengers; for first-class passengers the due will be 2½ centimes. The concessionaire company is also to provide not less than $100,000 nor more than $400,000, toward the completion of the new Boulevard Raspail. The new line is to be sunk at a much greater depth than the Metropolitan electric lines now in course of construction or already running; the tunneling will be at a depth of from 24 ft. to 115 ft. beneath the street surface. Contrary to what has happened in the case of the City Metropolitan line, the new company is to carry out the entire work at its own expense, and is to undertake to link up with existing lines at certain points. The work is to be carried out without any necessity arising to take up the roadway. The concessionnaires are Messrs. Berlier and Janicot, engineers and contractors. The Omnium Lyonnais, one of the most important electric traction concerns in France, is financing the scheme.

*TROLLEY CAR STREET CLEANING.*—As a result of suggestions by President Vreeland, of the Metropolitan Street Railway Company, of New York, and of conferences on the subject, a proposition will be submitted to the city, which, if accepted, will revolutionize existing methods of snow and garbage removal. The railroad company stands ready, on reasonable notice, to assume the functions now performed by contractors and sweepers employed by the Street Cleaning Department in Manhattan Borough. Should this proposition receive favorable consideration its scope may be broadened to embrace the removal by the transit companies of snow and household refuse in all of the five boroughs. This can be done, it is said, by the introduction of gondola cars on the several lines of street railway to be operated on a night schedule, and in emergencies by daylight. The cars will have to be constructed on a special plan, which Mr. Vreeland now has under consideration. The extent to which they may be adopted will depend upon the success or failure of the experiment in practical operation. If it is found that the cars can be operated without interference with passenger traffic and to better advantage than carts, there is little doubt that they will be generally adopted. The use of the cars as an adjunct of the Street Cleaning Department in the removal of ashes and garbage then will become a subject of negotiation between the street railway companies and the city. It is argued in favor of this plan that the city's refuse could be removed in the cars at night. It would be necessary to complete this system to use carts in the cross streets for a "short haul" to the nearest trolley line. The city already has the carts, and with the assistance of the railroads, it is contended, the service would be brought up to a high standard.

*MR. MARCONI RETURNING TO NEW YORK.*—A cablegram from Southampton announces that Mr. Marconi sailed for New York on the American Line steamer "Philadelphia" on Feb. 22.

*ENGLISH CABLE WORKS COMBINE.*—A cable dispatch from London, Feb. 22, states that the directors of the Henley Telegraph works announce in a circular issued to the shareholders that terms have been arranged by which the company will amalgamate with Callender's Cable Works.

*THE KING'S TROLLEYS.*—A cable dispatch from London of Feb. 15 says: Profiting by the example of Mr. Yerkes, the King is going into trolleys himself. He is furthering a plan to gridiron Windsor with trolley lines so as to open up some of the prettiest parts of the royal demesue and enable him to sell off some ineligible real estate at a good profit. The railways are opposing the scheme, but it is reported that the King is determined to obtain the grant of a franchise from the Windsor authorities.

*CHEAP TELEPHONY.*—A new telephone company has offered to Utica, N. Y., what is said to be the best return for a 25-year franchise ever extended to any city by a telephone corporation. The company offers to install a telephone in every house in the city where one is wanted and to charge a uniform rate of 2 cents for a five minutes' conversation. There will be no charge for instruments and none for messages received. Any merchant who wants more than one telephone can have as many as he desires at the same rates.

*WIRELESS TELEGRAPHY IN CANADA.*—In the speech from the throne, the Governor General of Canada, Lord Minto, said last week: "The inventor, Mr. Marconi, having met unexpected obstacles to the carrying on of his experiments in wireless ocean telegraphy in a sister colony, my ministers deemed it expedient to invite him to continue his operations on the coast of Nova Scotia, and they availed themselves of his presence in Canada to enter into negotiations, resulting in an arrangement through which, should the project prove as successful as is hoped for, the Government and people of Canada will enjoy the benefits of the invention on very favorable terms, including rates for transatlantic messages very much below those now existing."

*IOWA TELEPHONE ASSOCIATION.*—The sixth annual meeting of the Iowa Telephone Association will convene in the clubrooms of the Savery House at Des Moines, Iowa, on Tuesday, March 11, 1902, at 2 o'clock P. M., for a two-days' session. Among the important subjects which will be discussed is that of a clearing house for checking and settling balances between companies for interline toll business. The subject of rural lines is sure to receive much attention at this time. The programme committee will present fewer subjects than usual this year, and allow more time for general discussion. The programme will be announced in advance of the meeting, and it is hoped that members will take active part in the discussions following the presentation of papers. The secretary is Mr. Charles C. Deering, of Boone, Iowa.

*ELECTRO-MAGNETIC GUN.*—It is reported from London via Copenhagen, that experiments have recently been made in Christina with the new electro-magnetic gun invented by Professor Birkeland. "The electric connection between the battery and the gun was made in less than a second by the aid of a current-breaker. The electric spark was seen, and then there was a loud report, which was not, however, caused by the firing of the gun, which is absolutely silent, but was the impact of the projectile, a 1-lb. shell, on a wooden target, which it penetrated. The gun works magnetically. The shell is drawn out of the bore, and not, as hitherto, impelled by gunpowder. The use of magnetism as motive power, according to Professor Birkeland, will enable 1000-lb. shells to be hurled much further than by the old-fashioned methods."

*SHORT CIRCUITED NERVES.*—Electricity appears to be rapidly extending its magical charm over the medical profession, to judge from the frequent announcements of medical "discoveries" involving electricity. The latest is an announcement of a discovery by Dr. C. C. Carroll, whereby consumption, pneumonia and other diseases may be cured. The discovery of the wave theory of electric transmission, he says, permitted the discovery of the possibility of "short circuiting" a nerve. Dr. Carroll took up the subject of oscillations along the nerves and experimented and computed until he found that the rate of oscillations along a nerve is 300,000 per second, approximately. He then applied to Mr. Tesla and asked him to build an electrical oscillator capable of 300,000 oscillations. "After some hesitation he built the machine. It contains several miles of wire and is peculiar in that it requires but one pole for its practical use. The wave action is so rapid that they are neither positive nor negative." When the oscillator is set in motion the nerve action is "short-circuited because the oscillations of the electric current are the same as those of the nerve current, and all sensation is cut off from the brain. Only the sensatory nerves are affected. Voluntary muscular action is left normal." Such "short circuiting," he says, will allow of the performance of surgical operations, particularly on extremities and on external surfaces of the body, without pain to the patient and without the necessity of putting the patient under the influence of an anæsthetic. Dr. Carroll will shortly read a paper before the Medico-Legal Association and the Tuberculosis Congress, having for its subject "A New Theory of Medicine," and will deal with the application of electricity to the cure of consumption.

*REDUCTION BY GRAPHITE.*—Mr. Edward Goodrich Acheson, whose name is synonymous with the inception and development of the carborundum and artificial graphite industries, has just received a patent covering an interesting and important metallurgical application of the latter substance—its use as a conducting and reducing agent in electro-metallurgy. While graphite has been heretofore named as the equivalent of amorphous carbon for sundry reductions, it has remained for Mr. Acheson to clearly point out its advantages for resistance furnaces in which the current is carried by the charge. These are, first, its high purity, the contamination by the artificial graphite in particular being practically negligible; second, its high electrical and thermal conductivity, whereby current sufficient for the reduction can be transmitted and the heat distributed evenly throughout the mass, and, third, its extreme divisibility, which permits a truly intimate mixture with the ore to be reduced. That the above advantages are real is indicated by the fact that Mr. Acheson has succeeded in effecting the direct reduction of silicon from a mixture of silica and graphite, containing rather less than the theoretical proportion of the latter, and inserted as a resistance in a 100-volt circuit. It is true that Moissan has produced silicon by reduction by carbon (*Comptes Rendus,* June 4, 1895), but this was effected by heating mixed quartz and carbon in a cylinder of coke, by means of the arc. Mr. Acheson's discovery is that graphite, not in excess of the ratio required by the reaction, renders the charge a conductor and permits application of the resistance principle. Data as to the resistance of a charge so prepared indicate for a column 2 by 2 by 3 inches an initial resistance of 33 ohms, falling to 5 ohms as the reduction proceeds.

# LETTERS TO THE EDITORS.

## An Interesting Static Effect.

*To the Editors of Electrical World and Engineer:*

Sirs.—I have noticed a curious and very pretty effect of static electricity, an account of which may be of interest to some of your readers.

Sprinkle a thin sheet of white paper with finely powdered carbon dust and then hold beneath it a piece of hard rubber, such as a telephone receiver cover, which has been briskly rubbed with a piece of chamois. The dust will then form itself in rings and lines on the paper almost identically the reverse of those formed by iron filings when placed over a magnetic field. By gently tapping the paper many beautiful effects may be obtained, which are heightened if the piece of hard rubber is moved around beneath the surface of the paper. While this, of course, is of no practical value, yet it forms a very clear and pretty method of illustrating the presence and effects of a static charge.

LORAIN, OHIO. C. H. HINES.

## Synchronous Motor on Grounded High-Tension Lines.

*To the Editors of Electrical World and Engineer:*

Sirs.—Thinking it might interest some of yours readers to hear of a curious experience we had recently, I give below the particulars:

The 20-stamp mill in the works of the Standard Consolidated Mining Company, at Bodie, Calif., is run by a three-phase, 6600-volt, 180-kw Stanley synchronous motor, supplied with current from a water power generating plant 12½ miles distant, the line running over very rough and rocky country. During a sleet storm a short circuit on the line caused the motor to go out of step, but it was started immediately without any apparent trouble. The ground detector showed nothing wrong, but 10 days later, in going over the line, the cause of the trouble was discovered. On a high peak two of the wires were lying on rocks and on bushes, and not more than 6 inches apart. The third wire was caught on the top of the pole, the cross-arm being completely burned off. Of course, the fault was immediately repaired, but the motor had been running 10 days with the line on the ground.

BODIE, CALIF. F. J. GREISBERG.

# DIGEST
## OF
## CURRENT ELECTRICAL LITERATURE.

### DYNAMOS, MOTORS AND TRANSFORMERS.

*Starting Resistances.*—OTT.—A long, illustrated paper, read before the Newcastle section of the (Brit.) Inst. Elec. Eng. He complains that most starting resistances at present in use are made after the rule of thumb, and are quite unsatisfactory. Several types of earlier and present starting resistances are described. The principal point against which is sinned most is the sub-division of the resistance. The correct way is a geometrical sub-division with armature resistance as one extreme and total resistance as the other extreme. Certain modifications are required, however, as suggested by considerations of voltage, number of steps available in switch, and conditions of manufacture. The general rule is given by the formula that the total resistance must equal $A \times F^n$, where $A$ = armature resistance, $F$ = common factor, and $n$ = number of sections of resistance. For instance, a motor has to take 38 amperes at full load with an armature resistance of .25 ohms. The current on moving from one step to the next is not to exceed 10 amperes. The percentage increase is, therefore, $10 \times 100 \div 38 = 26$ per cent, and the common factor to be used is 1.26. The resistance, including the armature to the end of each section, is, therefore, $A \times 1.26$; $A \times 1.26^2$; $A \times 1.26^3$; and so on until $A \times 26^n$ equals the total resistance decided upon. For 14 sections the total resistance in this case becomes $0.25 \times 1.26^{14} = 6.3$ ohms. He then discusses the difficulties of construction, the supply requirements, the initial current, the condition of high voltage, the barrel type controller, variable torque, mechanically operated switches, liquid resistances and regulating resistances.—Lond. *Elec. Eng.*, Jan. 24, 31.

*Best Degree of Saturation for Polyphase Generators.*—KORRODI.—A brief article in which he proves that an increase of the induction in the field magnets up to a certain limit, diminishes the voltage drop and that to such a degree that a machine with a straight characteristic curve when loaded shows less variation of voltage, than a too highly saturated one, equal excitation being assumed. This is shown by means of diagrams.—*Elek. Zeit.*, Jan. 16.

### LIGHTS AND LIGHTING.

REFERENCES.

*Regina Arc Lamp.*—An illustrated article on this enclosed arc lamp of German make, for which the following advantages are claimed: The life of a set of carbons is 160 hours. The Rosemeyer system of shutting out the oxygen is used, in which the amount of oxygen entering the lamp is regulated by the arc itself. According to tests, by Wedding, of a 6-ampere, 110-volt Regina arc lamp, it consumes only 1.075 watts per Hefner candle.—*Elek. Rund.*, Jan. 15.

*Electric Night Lamp.*—HOPKINS.—An illustrated description of a home-made ½-cp electric night lamp, fed from dry cells.—*Sc. Amer.*, Feb. 15.

*Arc Lamps.*—The conclusion of the article on "Applications and uses of arc lamps," in which illustrated descriptions are given of various arc lamps of English make.—Lond. *Elec. Rev.*, Jan. 17.

### POWER.

*Power in English Railway Shop.*—An article on the new power equipment of the Metropolitan Railway, Carriage & Wagon Company's shops at Birmingham. Electric power is transmitted to the different departments of the works from the generating station which is equipped with gas engines and contains four gas generators, each capable of serving a maximum of about 250 hp. The generators are of the two-phase, alternating-current type and directly connected to the engines. The motors vary in size, most of them being between 30 and 60 hp. Different machines are not driven by separate motors, except in a few instances, but usually a 30 or 40-hp motor drives the shaft for each separate section or department of the works. The motors are self-starting under load, and have a considerable overload capacity. No part of the electrical circuit is exposed, and there are no rotating windings so that the motor is particularly adapted for the driving of machinery in dirt, or in corrosive or inflammable surroundings. Some particulars are also given of the arrangement of the shops themselves, and the car building machinery employed therein.—*St. R'y Jour.*, Int. Ed., Feb.

*Solenoid Drills for Hard Stone.*—HEUBACH.—A summary of the principles on which solenoidal percussive rock drills have been built, notably by Van Depoele, who used a combination of three solenoids surrounding an iron core, the center one being excited by direct current, and the two end ones by alternating current, which was derived, with a suitably low period, from a direct-current dynamo, by a pair of brushes revolving on the commutator with a speed governing the period. The more modern construction by Marvin using two solenoids alternately energized, and the special dynamo for use with this type of drill, are described. The method of obviating the difficulties of insulation by mica insulated coils of wire of square section is described. In the second part the electrical working is discussed, and the current and power factor with various lengths of stroke of the drills are shown by means of curves. The method of winding multipolar generators to give a number of periods, that is, of oscillations to the drill, equal to or greater than the number of revolutions of the machine, is described. Tables are given of actual results as to speed of working and cost. A comparison of weight and power is given, and the respective merits of percussion drills driven by a motor and flexible shaft, with those of the solenoid type, are discussed.—*Zeit. Ver. Deut. Ing.*, Oct. 19, 26; abstracted in *Science Abstracts*, Jan.

*Electrically-Driven Shipyard Tools.*—An illustrated description of two powerful electrically-driven tools of English make for shipyards. One is a plate-straightening machine, driven by a reversing motor, which is geared direct by spear-wheel and pinion to the rolls, and is provided with a liquid reversing switch that prevents injury to the armature through excessive current at the moment of reversing. The machine is fitted, in addition, with a magnetic brake, which brings the rolls to a dead stop the moment the current is switched off. Plates up to 6 ft. in width and 1 inch thick can be flattened in this machine. The other tool is an electrically-driven four-sided combined lever and eccentric type punching and shearing machine.—Lond. *Eng'ing*, Jan. 31.

REFERENCE.

*Transmission of Energy.*—W. C. L. EGLIN.—A paper read before the Engineers' Club, of Philadelphia, on the economical conversion and transmission of energy. He discusses in a general way, the development of the use of water power, the progress made in the construction of steam engines and gas engines, the use of compressed air, the development of electric transmission and the principal features of direct and alternating-current motors. He then deals with the load factor of the entire plant and gives a series of load diagrams, one of which is a composite diagram of the load of several

stations, showing the character of the load which must be carried, and also demonstrates conclusively that most of the work can be done by one main generating station operating under the most economical conditions, with the smaller stations acting as auxiliaries, the location selected being the best suited to the particular requirements of the load that they must carry.—*Proc. Eng. Club.*, Phila., Jan.

### TRACTION.

*Engines and Batteries for Tramway Power Stations.*—An anonymous article in which the writer urges that as a gas engine is essentially an engine to run at a steady load, it should be supplemented by a storage battery. If a shunt generator is used with a falling characteristic of sufficient range, and is worked in conjunction with a battery of liberal proportions, the battery will work in parallel with the generator and take up load when this passes the mean load, or it will absorb current at low loads. There appear to be certain advantages in placing the battery at a sub-station. The maximum output of the battery is the surplus of the maximum above the mean load. On a small system, the battery output will be much greater for short periods than the station output, and the divisions into which the battery sub-station divides the line will correspond with the ratio of battery output with station output. For example, with a load factor of one-third the battery output at a maximum will be two-thirds, and the battery would be placed so as to divide the line into sections having a ratio of 2 to 1, the longer section being between power house and sub-station, or approximately so, then at times of maximum load, one-third the current goes from the battery outwards towards the extremity of the line, one-third goes from the battery towards the stations, and the remaining third goes from the station towards the battery. After some calculations, however, the writer comes to the conclusion that only in the case of a single line extending from the power station can a battery be installed other than at the station, except at considerably enhanced cost, and this is more particularly so in small than in large systems, because in a small system the load factor improves rapidly with the growth of the system up to a moderate figure, and thereafter but slowly. The accumulator at present stands as the greatest obstacle in the way of extending polyphase working to small and moderate systems.—Lond. *Elec. Rev.*, Jan. 25.

*Earth Currents Derived from Distributing Systems.*—WEDMORE.—A paper, illustrated by many diagrams, read before the (Brit.) Inst. Elec. Eng. He considers the current distribution, accompanying the use of the earth as a return in a simple traction system, and approaches the problem from the magnetic side. Should the whole curent return by the rails, then the magnetic effects due to the current in the trolley wires and rails would practically cancel, except in the immediate neighborhood. A large proportion of the current, however, returns by the earth, and at a distance from the trolley wire. The magnetic effects due to the current in the trolley wire, therefore, are not canceled by the return currents. On the assumption that the specific conductivity of the earth is uniform, and that the return currents enter and leave at points, it follows that the magnetic force directly due to the earth currents has no vertical component. No part of the vertical component due to the current in the trolley wires and feeders is canceled by the earth currents. Except close to the line, the magnetic field due to the current in the trolly wire has no horizontal component. His discussions are largely theoretical, and the results obtained by various investigators are dealt with. At the end of the paper he makes the following remarks. In the past, electrolytic troubles have been much over-rated, and in many cases corrosion not due to earth return currents, but to the use of inferior metal, have been attributed to the return current. Cast iron has been found more free from corrosion than wrought iron, and oxides produced at the seat of electrolysis increase the resistance, and reduce the electrolytic current. "If one had in one's power to lay both pipes and track in the best possible manner, it would seem best, where metal pipes are used, to use cast iron, to introduce resistance at every joint, to introduce any possible surface resistance, and to avoid all connections with the rails, leaving the rails to take their own potential." An account of the discussion which followed is also given. —Lond. *Elec.*, Jan. 24, 31.

*Aurora, Elgin & Chicago Railroad.*—An illustrated article on construction work on this road, which is an important high-speed line now being built. The schedule speed is 40 miles per hour, including stops, with stations 3 miles apart. The cars weigh about 40 tons each. The maximum speed is 65 miles per hour. Each car will be equipped with four 125-hp motors. There are no grade crossings. The rails weigh about 80 lbs. per yard, and are laid in 60-ft. lengths. The third rail is to be used, except in two towns, where the trolley system will be used. The third rail will weigh about 100 lbs. per yard. Power is distributed at 26,000 volts, and the generating units will be of 1500 kw capacity. The feeders will be of aluminum.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

#### REFERENCES.

*Electrification of Railways.*—An article referring to a recent statement of Langdon that it was to the main lines that he looked for the greatest success in the application of electric power. This is called a speculation on the probabilities of the future, while the urgent needs of the present are the extension of the suburban electric lines.—Lond. *Elec. Rev.*, Jan. 24.

*Electric Locomotives.*—An article giving statistics on electric locomotives and containing a table compiled by the General Electric Company of the main dimensions of the electric locomotives built by it.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

*Hartford and Springfield Street Railway.*—A short illustrated description of this interurban trolley line.—*St. R'y Jour.*, Feb. 1., and Int. Ed., Feb.

*French Tramway Line.*—PAUSERT.—A long illustrated description of the tramways between Vincennes, Nogent, and Ville-Evrard; the trolley system is used.—*L'Eclairage Elec.*, Jan. 25.

*British Electric Tramways.*—A map of the United Kingdom, showing the electric railways and tramways in operation and under construction.—Supplement to Lond. *Elec.*, Jan. 31.

*Dangers from Trolley Wires.*—JAMIESON.—An illustrated article on dangers from trolley wires and other aerial electric conductors, and on the methods used in Great Britain to guard against them.—*Cassier's Mag.*, Feb.

*Street Car Platforms.*—PARTRIDGE.—The third and concluding part of his well illustrated serial on this subject.—*St. R'y Jour.*, Feb. 1, and Int. Ed., Feb.

### INSTALLATIONS. SYSTEMS AND APPLIANCES.

*Economy of Isolated Electric Plants.*—PARSONS.—The conclusion of his article in which he deals with buildings for residential purposes, including apartment houses, hotels and clubs. He analyzes carefully the cost of operation in several buildings in New York. The statistics of the 17 buildings which he has discussed in detail show, as a whole, the decided advantage of the isolated plant over the central station service. Curiously, it is usually in the smaller buildings that the greatest percentage of gain is found, this being due partly to the greater proportional saving brought about by heating the building with the exhaust, and partly to the fact that there is more relative difference between the central station rates which the small building would pay and the cost of production in the isolated plant, than there is between the central station rate the large buildings would pay and the cost of generation in its isolated plant. The small plant is, however, much more sensitive to unfavorable conditions of any kind. Though the central station rate never reaches so low a point as the least cost per kw-hour in a very large isolated plant, the decrease as the amount of current increases is greater in the central station rate than in the cost of production in the isolated plant. The following factors are of the greatest importance for the economy. The insallation of the right number of generators, of such size that they may be operated as nearly as possible at full load. Heating in the smaller buildings is a very important factor, and, in some cases, the current is produced for exactly the price at which it would be furnished by the central station, the only gain being the cost of heating. Could the central station supply steam at low rates along with electricity, the days of the isolated plant, in the smaller apartment houses and clubs and in many loft and office buildings, would be numbered. When the building is large, the amount which would be expended for heating, were no plant installed, is still gained, but it is a much smaller proportion of the total cost of running the building, and is relatively a less important factor. Important for economy are the shape of the load diagram; the keeping of careful daily records of output, supplies and expenses; the competency of the engineer; the temperature and ventilation of the engine room; the amount of coal storage capacity. The type and number of elevators used, apart from their efficiency as elevators, also affects the economy of operation. In one of his instances, an electric elevator is used and necessitates the operation of a large dynamo

most of the day at an extremely light load, whereas were no elevator present, or were a hydraulic elevator used, a very small dynamo could be employed for the small constant day load; or this small amount of current could be taken from the central station at very little extra cost. In this connection the potential regulator may play an important part. The storage battery is one of the most important factors in the economy of the isolated plant, and it furnishes another means by which electric elevators can be run from the same dynamo as the lights and at the same time sudden fluctuations of voltage can be avoided.—*Eng. Mag.*, Feb.

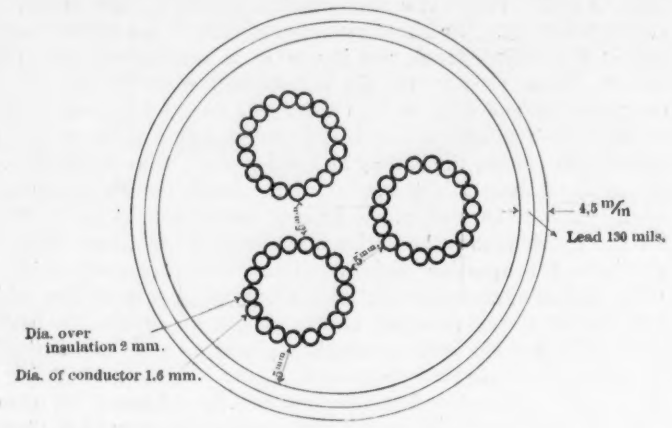
*Melbourne.*—An illustrated description of the Melbourne municipal electric lighting station. There are four 350-kw sets and one 200-kw set of direct-current dynamos, supplemented by a battery. The three-wire system of distribution is used at a pressure of 460 volts across the outers, being carried out at present to a distance of about 1.5 miles from the power house. The outlying area of the city is supplied with alternating current at 100 volts, the transmission being at 2000 volts, two 75-kw alternators in the station being driven by direct-current motors.—Lond. *Elec.*, Jan. 24.

*Electric Installation in an Asylum.*—A well illustrated description of the electric light and power installation at the Lancashire County Asylum, Rainhill. There are three 118-kw shunt-wound direct current generators, the voltage being 230, and a battery of 130 cells, with a capacity of 1200 ampere-hours at a nine-hour rate. The total number of lamps connected exceeds 3520 of 16 cp, and in addition there are motors for ventilating and refrigerating purposes.—Lond. *Elec. Eng.*, Jan. 17.

*Devices for Disconnecting Transformers.*—Geist.—An article on devices used for connecting and disconnecting the high-voltage winding of a transformer from a distance, when, from the low-voltage side, current is taken off or not, respectively. Such devices have been used in order to diminish the no-load losses and also the phase difference. He discusses in a general way under which conditions they are economical, and reaches the result that in general they are not. In special instances, of course, they may be used to advantage. —*Elek. Zeit.*, Jan. 16.

### Wires, Wiring and Conduits.

*French Cable Factory.*—O'Gorman.—An illustrated description of the cable works of Berthoud Borel & Co., at Lyons, of which he speaks very highly. They take 400 hp exclusively from the public three-phase, 2500-volt supply at 8 cents a unit. The lead press pumps are actuated by 50-hp motors, and they do not absorb more than 30 hp each at full load and at 700 revolutions of the motor, and 180 throws per minute of the three-throw pump. They use a system of double-lead covering, with bitumen between the coats. They have given up the use of the water tank. In the drive of the lead-press pumps the three-phase motor is ideal, the drive being steady and the motor nearly always working at full speed. The textile machines, the paper coverers, lappers, cotton coverers, braiders, etc., gain a most important advantage from the use of the three-phase motor. The speed is independent of the local drops of voltage which may be caused by the sudden starting of the two or three lead presses, and breakages, if they occur, are due to weak places in the material and not to the jerks of the machine. Several of the machines are illustrated. The most interesting cable made at these works is their standard model which embodies a new arrangement of the conductor intended to diminish the impedance of large copper sections, and at the same time improve the resistance to puncture of the dielectric. The adjoining diagram gives a section of a 3500-volt cable, of which very many miles have been working for years in Lyons. Three wires each of 100 sq. mm. section, insulation thickness 5 mm. paper impregnated with hydro-carbon oils; insulation on each fine wire, 0.2 mm. paper and 18 fine wires round each main conductor. Each conductor is thus surrounded by a complete ring of what might be called pilot wires all at the same potential as the main conductor which they encircle. The amount of insulation on each outside wire is very small, only 0.2 mm., and the diameter of the copper of the outside wires is always kept at 1.6 mm. for uniformity of manufacture, no matter what size of main conductor is in use. The immediate effect of adopting the system has been to reduce the radial length of insulation from 7 mm. to 5 mm., with a corresponding cheapening of the cable. The improved conductivity of the cable at 50 periods for three-phase 150 sq. mm. cable, was 6 per cent, i. e., the impedance factor with stranded copper was 1.46; the impedance factor with the insulated wires was 1.32 coincident with the diminution of the thickness of insulation over it. The novelty is the arrangement of conductors, namely, the separate insulation of the outer strands. The insulation consists of the ordinary low-tension material, resin and vaseline oil, on a basis of good, dry paper. He witnessed the experiment of breaking down a 5000-volt cable. At about 20,000 volts, when breakdown occurred, each separate insulated strand sparked across to its main conductor at the cable end exposed to the air, owing to the main being reduced to the potential of the lead sheath at the point of internal breakdown. He gives a table of capacities of these three-phase cables, from which the following is an abstract: For




SECTION OF 3500-VOLT CABLE.

3500 volts, section 3 by 10 sq. mm., 0.177 microfarad per mile; 3 by 150 sq. mm., 0.37 m. f. p. m. For 5000 volts, 3 by 30 sq. mm., 0.209 m. f. p. m.; 3 by 120 sy. mm., 0.321 m. f. p. m. For 10,000 volts, 3 by 20 sq. mm., 0.16 m. f. p. m.; 3 by 170 sq. mm., 0.29 m. f. p. m. For 20,000 volts, 3 by 18 sq. mm., 0.145 m. f. p. m. The capacity is measured between any one phase, and the other two connected to earth. For the three higher voltages the capacities are for cables having insulated strands round each phase.—Lond. *Elec. Times*, Jan. 16, 23.

*High-Tension Fuses.*—Semenza.—A description of the various forms of high-tension fuses now in use. Of those in air, he prefers the type in which the fuse wire is enclosed in a tube open at the ends, so that the expansion of the air blows out the arc. When used for large currents, the amount of metal vaporized is considerable, and the vapor cloud may cause the formation of an arc between the fuse-blocks. This having frequently occurred in the Paderno installation, he substituted fuses immersed in oil, and found them in every way more satisfactory. The size of the wire for the same fusing current is less in oil than in air, and it is of decided advantage to reduce the amount of metal to be fused. Copper, however, is not suitable, owing to its high temperature with a normal working current. Of pure metals tin was found to have the lowest temperature for a working current taken as a given fraction of the fusing current. A lead-tin alloy of equal parts is still better in this respect, but alloys have the disadvantage of uncertainty in their fusing points. The ratio of the maximum working current—for a given temperature of the wire—to the fusing current, may be increased by the use of heavy oils, such as ordinary cylinder oil. He has used fuses in vertical tubes filled with oil on 14,000-volt circuits and obtained satisfactory results.—*Elettricita*, Aug. 3, 10; abstracted in *Science Abstracts*, Jan.

#### Reference.

*Manufacture of Submarine Cables.*—An illustrated article on the new cable works of Siemens & Halske. The article is divided into the following portions: Heavy cables, spun and braided wires, gutta percha and rubber cables, paper-covered cables.—*Sc. Amer.*, Feb. 8.

### Electro-Physics and Magnetism.

*Electric Tubes of Force.*—De Nicolaieve.—A description of some novel experiments concerning the properties of electric tubes of force, illustrating the tension along the tubes in an instructive manner. Two bands of tinfoil, immersed in distilled water, serve as electrodes. They are separated from one another by plates of mica or other insulating substances, various arrangements being used. When the current passes, the tinfoil electrodes are displaced, owing to the contraction of the tubes of force. Or if the electrodes are fixed and the diaphragm floats, the latter moves. On dissolving some common salt in the water, the current becomes stronger, but the electro-

static field becomes less, and no motion of the electrodes or of the diaphragm is observed.—*Comptes Rendus,* Dec. 30; abstracted in Lond. *Elec.,* Jan. 17.

*Sensitive Vacuum Discharge.*—VON CZUDNOCHOWSKI.—A description of an experiment in which he uses a vacuum tube consisting of two spheres 6 cm. in diameter, joined by a tube 12 cm. long and 1 cm. in diameter. Each sphere contains a cathode, placed so that the rays are at right angles to the connecting tube. One of the cathodes is plane, while the other is concave. The anode is contained in a side tube attached to the middle of the connecting tube. When both cathodes are working in parallel the whole connecting tube is filled with positive light. But at a certain exhaustion one-half of the connected tube becomes dark, while the other remains light, the whole discharge passing through the plane cathode. If at this stage the sphere containing the concave cathode is touched with the finger the whole discharge jumps across into the neighboring portions of the connecting tube and returns as soon as the finger is removed. After further exhaustion the same thing happens when the observer merely approaches within a couple of yards, but the sensitive state disappears on still further exhaustion.—*Phys. Zeit.,* Jan. 1; abstracted in Lond. *Elec.,* Jan. 17.

*Reflection of Radium Rays.*—TOMMASINA.—An account of experiments with which he succeeded in proving the existence of radium rays which undergo reflection, and in separating them out from among those which do not. A small tube, containing a radium preparation, was mounted in the axis of a parabolic mirror made of silvered copper, which concentrated the rays upon a charged electroscope. The measurements showed that the mirror doubled the effect of the preparation. This great increase cannot be due to the secondary rays emitted by the surface of the mirror. This was proved by the author by introducing an iron cylinder on the axis of the mirror in such a way that the points of the mirror which could send secondary rays in the directions of the electroscope were not exposed to the direct rays of the radium preparation. It was found that the cylinder intercepted two-thirds of the radiation. A sheet of brass 0.5 mm. in thickness completely intercepted the reflected rays, but did not sensibly affect the main radiation.—*Comptes Rendus,* Dec. 30; abstracted in Lond. *Elec.,* Jan. 24.

*Primary and Secondary Röntgen Radiation.*—ALLEN.—A preliminary note on the relation between primary and secondary Röntgen radiation. When the Röntgen radiation from a focus-tube falls upon the surface of certain solids, the surface becomes the source of a secondary radiation. The object of his investigation was to compare the total ionization produced by the secondary rays with that which would be produced by the primary if they continued their path in the original medium. Then, supposing that the total ionization if not equal to, is at least proportional to the energy of the radiation, he obtains a measure of the ratio of the energies in the two kinds of radiation. From his experiments it follows that the total energy of the secondary radiation only amounts to about one-two-thousandth part of the energy of the primary radiation.—*Phil. Mag.,* Jan.

*Radio-Activity of Thorium Oxide.*—FEHRLE.—An account of experiments showing that at least the more penetrating radiation of thorium oxide is due to the emission of particles of matter. He regards the radio-active oxide as in a perpetual state of decomposition, one of the products of this decomposition being the rays which possess the greatest penetration.—*Phys. Zeit.,* Jan. 1; abstracted in Lond. *Elec.,* Jan. 17.

### ELECTRO-CHEMISTRY AND BATTERIES.

*Formation of Peroxide Plates.*—A description of a process used by a German company. A metallic lead plate is first used as anode in dilute sulphuric acid, until a brown layer of peroxide of lead is formed. The plate is then washed and put into a bath of very dilute nitric acid in pure water. When it then gets a gray color, it is taken out and again used as anode in dilute sulphuric acid, and so on. This alternative treatment is continued until the plate has the capacity which is wanted. This treatment not only saves time, but also enables one to get a high capacity as the formation enters more deeply into the plate. Only a relatively very small amount of nitric acid in water must be used. A solution of 1.5 per cent has been found to be sufficient. A too concentrated solution injures the subsequent formation.—*Elek. Rund.,* Jan. 15.

*Electric Manufacture of Carbon Bisulphide.*—TAYLOR.—Illustrations, with a description of an electric furnace for making carbon bisulphide. The furnace is of upright or stack form. Sulphur is placed in the bottom of the working chamber of the furnace and as far around the electrodes as may be deemed advisable. Fragments of broken carbon or coke are placed upon or between the electrodes, and the whole upper body of the furnace is filled with charcoal. As the sulphur is vaporized, the vapors pass off through the hot charcoal, combining with it and forming the vapor of bisulphide of carbon, which passes off through a side pipe at the top to a condenser.—*Elec. Rev.,* Feb. 1. (A detailed description of the Taylor furnace will be found in ELECTRICAL WORLD AND ENGINEER, Dec. 21, 1901.)

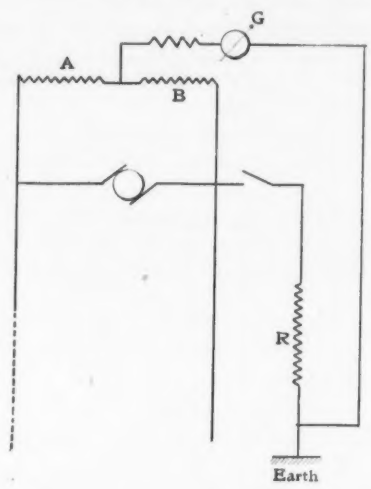
REFERENCES.

*Electrolytic Deposition of Lead.*—LINN.—A brief note on an Am. Chem. Soc. paper, stating that lead can be deposited electrolytically in a form suitable for weighing, from a solution containing free phosphoric acid.—*Science,* Jan. 24.

*Primary Batteries.*—An editorial note on primary batteries. Standard cells for laboratory and testing purposes excepted, the only really important improvement in primary batteries during the last two decades has been the introduction of the dry cell. The difficulty in "dry" cell construction has always been to keep the cell moist.—Lond. *Elec.,* Jan. 24.

### UNITS, MEASUREMENTS AND INSTRUMENTS.

*Bridge Method for Measuring Insulation Resistance.*—EISLER.—An illustrated description of a bridge method for measuring the total insulation resistance of a direct-current network during the time of service. The adjoining diagram shows the method as applied to a




MEASURING INSULATION RESISTANCE.

two-wire system. At any point of the system, for instance, at the switchboard, two adjustable resistances $A$ and $B$ are connected between the two sides of the system. The joining point of $A$ and $B$ is connected to one pole of a galvanometer, the other pole of which is connected to earth. A known resistance $R$ can be connected between a point of one side of the sytem and earth. At the beginning $R$ is disconnected, and $A$ and $B$ are so adjusted that the galvanometer shows no current. The ratio of $A$ to $B$ in this case may be $M$. Now $R$ is connected between the system and earth, and $A$ and $B$ are again so adjusted that the galvanometer shows no current. The ratio of $A$ to $B$ in this case may be $N$. Then the total insulation resistance is $R$ multiplied by the ratio of $N - M$ to $M + 1$. The same method may be used for a three-wire system. $A$ and $B$ are here connected in series between the outers, and $R$ between earth and a point of that outer to which $B$ is connected. The total insulation resistance is then again given by the same formula. Several numerical examples are given for illustrating the method.—*Elek. Neu. Anz.,* Feb. 1.

*Quadrant Electrometer.*—DOLEZALEK.—A description of a new form of quadrant electrometer. Owing to the disturbing influence of magnetic forces, the galvanometer has reached the limit of improvement. It is, therefore, desirable that the electrometer should be brought up to the same high standard of efficiency. The chief difficulty in the way of improvement in the quadrant electrometer is the necessity of charging the needle. If this is done through the suspending wire, the latter offers a considerable turning moment, unless it is made of silvered quartz fiber, which, however, is extremely difficult to pre-

pare and manipulate. He, therefore, suggests the use of a quartz fiber rendered slightly conducting by dipping into a solution of some deliquercent salt, such as calcium, or magnesium chloride. The conductivity thus acquired is practically permanent, and is sufficient for charging the needle. The latter is of the lightest kind, made of what is sometimes called in Germany "silver paper," i. e., paper covered with a layer of zinc and cut into the form of the usual needle. In the actual instrument the quartz fiber is 0.009 mm. thick, and the needle has a period of oscillation of 18 seconds. The instrument measures a difference of potential of 0.001 volt within 10 per cent and 0.1 volt within 2 per cent or less. He also tried to avoid the use of a conducting fiber altogether by suspending with the needle a small dry cell, which would keep it charged, but he found the cell got exhausted in a few months.—*Zeit. f. Instrumentenkunde,* Dec.; abstracted in Lond. *Elec.,* Jan. 31.

REFERENCE.

*Cable Testing.*—Savage.—The conclusion of his article on the methods of eliminating corrections for the leads, etc., in cable testing. The article is well illustrated by diagrams.—Lond. *Elec. Rev.,* Jan. 24.

### Telegraphy Telephony and Signals.

*Wireless Telegraphy.*—Some editorial notes on the business scope of wireless and cable telegraphy. Marconi's achievement "is far more likely to lead to more rapid methods of working submarine lines than to general instantaneous communications through the air." . . . "The greater the knowledge of the subject the more assured is the conviction that the true field of this latest method of electric communication is for comparatively short distance, and in cases where it is difficult or impossible to maintain wires." . . . "It would be a thousand pities if etheric communciation were to be set to bridge great distances, for which it shows no sort of fitness, to the neglect and injury of the potentially vast field of usefulness where it is urgently needed—namely, principally in connection with shipping." Reference is made in this respect to a recent speech of Barry to the stockholders of the Eastern Telegraph Company.—Lond. *Elec.,* Jan. 31.

*Wireless Telegraphy versus Submarine Cables.*—A second and third article, giving the opinions of various British engineers on the probable commercial results of Marconi's experiments. Most of them do not think that the submarine cable would have to fear anything from the competition of wireless telegraphy. There is, however, a long eulogy of Marconi's achievement by Guarini.—Lond *Elec. Rev.,* Jan. 24, 31.

REFERENCES.

*Wireless Telegraphy.*—Tobler.—The first part of a long and well illustrated description of various forms of transmitting and receiving instruments for wireless telegraphy, as made at present for commercial installations.—*Jour. Teleg.,* Jan. 25.

*Wireless Telegraph Apparatus.*—Collins.—An illustrated article giving practical suggestions for constructing an efficient wireless telegraph apparatus at a small cost.—*Sc. Amer. Sup.,* Feb. 15.

*Telegraphy in 1901.*—A general review of the development of telegraphy and telephony in 1901 in various countries.—*Jour. Teleg.,* Jan. 25.

*Telegraph Steamer.*—An illustrated article on the new British steamer "Viking" for laying and repairing telegraph cables.—Lond. *Elec. Rev.,* Jan. 31.

*Submarine Cables.*—The first part of an illustrated article in which, after a brief description of the construction of the usual types of submarine cables, the general formulas are given which govern the dimensions of the design.—*Jour. Teleg.,* Jan. 25.

### Miscellaneous.

*Electric Arc Furnace for Making Glass.*—Du Welz.—An illustrated account of experiments made by Henrivaux. There are three steps, made of a refractory material, on each of which a powerful arc is at work. The glass-making mixture is fed from a hopper on the top step, and passes successively through the arc on each step, finally falling in molten drops itno a basin, where it is kept fused by coke or gas for refining. The results obtained up to the present show that the system is very wasteful of heat, as compared with modern gas-fired glass furnaces, which can be worked with from 1.5 to 2.8 kilogram of coal per kgr. of glass made, while the figures obtained show that "a current equivalent to 9.3 kgr. of coal" was used per kgr. of glass made electrically. The inventors believe that they will finally succeed in reducing this to an equivalent of from 1 to 1.5 kgr.—*Ass. Ing. El. Liege,* Sept. 21; abstracted in *Science Abstracts,* Jan.

*British National Physical Laboratory.*—An article stating that the alternations required to fit up Bushey House as a laboratory are now practically complete. Up to the present the work of the laboratory has been carried out at Kew observatory. Immediately after the opening, attention will be directed to the following new branches of testing work: Tests of pressure gauges and engine indicators; magnetic tests of iron for permeability, hysteresis, etc.; insulation and resistance tests; tests on electrical apparatus not coming under the purview of the Board of Trade; microscopic and other tests of steel for rails and other metals; measurements of gauges and standards for use in engineering works; measurements of standard screws; tests on glass measuring vessels; flasks, burettes, etc., for use in chemical laboratories and elsewhere; tests on weights for laboratory use; thermometer and pyrometer testing.—Lond. *Elec.,* Jan. 24.

## New Books.

Wireless Telegraphy. A Popular Exposition. Second Edition. By C. W. Tunzelman, B. Sc. London: Office of Knowledge. 104 pages, 30 illustrations. Price, 1 shilling 8 pence.

The author of this treatise has found space within the confines of 100 pages to tell much, and with considerable detail of the rapidly advancing art of wireless telegraphy. To those who are interested in the classical experiments which led finally to the magnificent practical results achieved by Marconi, this book will be well worth the reading. For instance, the phenomenon Faraday discovered showing the relation between light and a magnetic field, is explained clearly in a few lines; and again the fact that a wave of light excited from a given source does not emit the radiation from the source itself, but from a point a quarter of a wave-length in advance of it, are only two of the many bits of information, allied to wireless telegraphy of interest contained therein.

The analogues given to illustrate mechanically the principles of the Leyden jar and those of the ether, seem a little out of proportion for so popular an exposition, and one is lead to suspect Fleming is right when he says that it is easy to become a slave to analogues. However, the mechanical models are much clearer than the more vague and untangible disturbances in the ether we call electricity and others we term electric waves.

The last quarter of the book treats of the Marconi system to the exclusion of all others, and to one unfamiliar with the work of other investigators they would be justified in believing Marconi is alone in the field, which brings to mind the story of the young lady who, on seeing for the first time an electric light, exclaimed, "Is it not wonderful how Edison invented electricity." As a history of what Marconi has done it is very good what there is of it.

Central Electrical Stations, Their Design, Organization and Management. By Charles Henry Wordingham, A. K. C. London: Charles Griffin & Co., Limited. 500 pages with 136 illustrations and folding plates. Price, $7.50 net.

Judging from the title of this work, one would expect to find a broad and comprehensive and at the same time deep and exhaustive treatise on the subject of central stations, dealing with the problems which arise in their design, organization and management. On the contrary, and greatly to the disappointment of the reader, this volume is little more than a description of the methods employed and the apparatus used by a corporation or municipality in operating its central stations for the supply of light and power to be used in the same city in which the plant is located; commencing with the location and structure of the station building, describing the generating and distributing apparatus, the connection to the customers' premises and the laying out of the general office work.

If the description had a broader scope and a more universal sympathy, not only would its value be greatly enhanced, but it would also be much more convincing; but the author has confined his treatment, almost entirely, to engineering customs from an English standpoint, and that very largely from the experiences of a single plant located in Manchester, England.

The book presents a very good picture of English central station engineering and business policy as viewed by English eyes, but lacks

the breadth of experience to be of universal value and lends itself merely as a single example of one branch of electrical art.

The point of view of the author is evidenced in a characteristic manner by the attitude assumed in the following statement, quoted from the chapter on "Central Station Work as a Profession."

Speaking of whether a youth should seek his technical training in England or abroad, the author writes: "Now, if the years in question be spent abroad, golden opinions may be earned, but they will be wasted so far as advancement is concerned, because those holding them do not come into contact with the persons among whom the student is thrown. He returns to England unknown, and has to start afresh, and to make new friends with far fewer opportunities of doing so than he had at college." It may be added that the author is directly connected with a technical institution in his own city.

As a text-book for schools or colleges, this work should find a place, as it deals with many of the engineering problems of central station work, and describes in detail apparatus in use and methods of operation which are of interest to the student, but which would be but little more than a matter of history to the modern electrical engigineer.

In some parts of the book the author goes needlessly into detail in the description of some minor piece of apparatus, while at another time a matter of greater importance is lightly passed over with merely an allusion being made to it. There are a number of gems throughout the book which are very valuable, the subjects being treated in a straightforward and masterly manner, but they are set in such a profusion of commonplace material that a reader tires before they are discovered and rescued. The book would have been far more valuable if a considerable part of it had been omitted, and the remainder stated in a more concise manner with a broader view and from various standpoints.

The first five chapters are in the form of a general introduction, treating the subject of central station work as a profession and investment, also the establishment of the central station and the system of supply from the station of the customer. Chapter VI. to VIII. deal with the generating station, discussing its location, architectural features and general design. The discussion is rather general and somewhat theoretical, but contains many interesting and important facts which, although already known by the engineer, are of interest to the student.

The chapters from the ninth, including the seventeenth, have to do with the apparatus contained in the station, such as boilers and boiler accessories, the generators, both steam and electrical, as well as the switches, instruments and electrical connections. There are also discussed the firing and feeding of boilers, the handling, weighing and storage of coal, the transmission of steam and condensing appliances. These chapters are very elementary in character, a great deal of space being devoted to describing and illustrating different types and makes of apparatus with minute description as to their mechanism and manner of working.

Chapters XVIII. to XXIV. are devoted to underground systems of electrical transmission, beginning with those which have long since outlived their usefulness and describing others which are being installed at the present time. There are treated in this section different kinds and makes of distributing mains (both the "drawing-in" and "built-in" systems), various dielectrics, insulation resistance and cost, distributing networks, service mains and feeders, also the testing and recording of the laying of mains.

This discussion has a very local flavor, terms being employed and usuages being described which would have little application in another locality or under different conditions.

Chapter XXV. describes somewhat in detail the different classes and types of meters and other appliances located on the customers' premises, followed by a chapter on the testing of meters, also the design and use of a general testing laboratory. Chapter XVII., on secondary batteries, is a general and somewhat superficial description of storage batteries with regard to their structure, use and methods of charging, together with the switches for operating the same.

Chapter XXVIII. deals with the general subject of street lighting, discussing the different systems employed, kinds of lamps used, the operation of the lamps and the supply of current to them. The cost of producing electrical energy is taken up in Chapter XXIX., and is rather above the average in point of practicability and cleanness; statistics in the form of tables and curves being added which increase greatly their interest and value.

Chapter XXX., on the methods of charging, is an up-to-date discussion of the subject, and is one of the most valuable chapters in the book. It takes up very fully the different classes of customers, together with the rates of charging justifiable in separate cases, also the various ways of measuring the amount and character of the current used. Chapter XXXI., on the regulation of consumers' installations, contains little of interest to the American reader. Chapters XXXII. to XXXVIII. deal with the organization of a central station, taking each department separately, and giving a list of the officers and clerks required, as well as the forms to be used, both of which would vary in almost every instance, and hence are of interest merely as an illustration of what has been done under certain conditions.

The last two chapters, on the consumer and the routine of main laying, are a general description of the movements necessary, and the instruments to be used in laying the underground conductors and connecting the same in the customers' premises, ready for service. The various blank forms added throughout the book are extremely local and cumbersome, and are valuable only as suggestions rather than models.

As stated before, the work, as a whole, is better fitted for a general text-book than for a guide to a practical engineer.

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HANDBUCH DER ELEKTRISCHEN BELEUCHTUNG. Von Joseph Herzog und Clarence Feldmann. Second Edition. Berlin: Julius Springer. 619 pages, 517 illustrations, 5 plates. Price, 16 marks.

The authors of this work are well known to the reading electrical engineering public, and both have largely contributed to the literature of the calculation of closed and open electric networks. The book is divided into nine chapters, the first of which is devoted to the sources of illumination, including projectors, illuminated fountains, and combinations of sources of light for advertising purposes. The second chapter deals with electric wiring, describing in detail the construction of insulators for indoor and outdoor work, conduit systems, and cables. In the third chapter the different combinations of the generators and transformers in the central station are described, including discussions on the potential drop in alternators and the oscillation of alternators operating in parallel. A paragraph is devoted to single and polyphase induction motors.

The regulation of direct and alternating-current systems is described in the fourth chapter, space being given to some very ingenious end-cell regulators widely in use in European central stations built by the Schuckert Company. Regulators for alternating current systems are treated rather briefly, American constructions not even being alluded to.

In the fifth chapter on auxiliary apparatus we miss the description of oil switches which, owing to their constantly growing importance, should not be omitted in any book in which switches for alternating currents are treated; also the space given to lightning arresters seems utterly inadequate, considering the many pages devoted to electric fixtures.

The book winds up with two chapters on central station work, giving descriptions of some interesting stations, and being full of interesting and useful suggestions to the thoughtful and critical reader.

A work like that of Mr. Herzog and Mr. Feldmann, intending to cover almost the entire field of electrical engineering, must needs be of a somewhat encyclopædic character, and, therefore, slur over difficulties, and dwell on details and unimportant subjects at greater length than it would be desirable in a work of a more special character. The authors, however, have succeeded in writing a very interesting work, the study of which will well repay the reader, and the practical engineer will find many interesting paragraphs which reflect the valuable experience of the authors.

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We have received from H. Alabaster, Gatehouse & Co., of London, the new 1902 edition of their Berly's "Universal Electrical Directory," bound in scarlet cloth, and issued in England at $2.50. It is a standard publication, and is very useful to all having international correspondence or business. It comprises the names of the members of the electrical and kindred industries throughout the world. The book has been most thoroughly revised, and the British alphabetical section now comprises about 10,640 distinct names; Continental alphabetical section now comprises about 9240 names; United States alphabetical section now comprises about 5830 names; colonial alphabetical section now comprises about 3190 names; or a total of 28,900.

For simplicity and facility of reference it is divided into four

groups, namely: British, Continental, American and Colonial, which are again sub-divided into alphabetical and classified sections. In the case of the British a geographical section is given, making in all nine sub-divisions.

In addition to the new names incorporated in the present issue, much financial information is given, the telegraphic addresses and local telephone numbers are given, and the pages added to the work are 36 in number, as compared with that of 1901, making in all about 1280 pages entirely of directory mattery. The lists of central stations in the United Kingdom and colonies have been considerably added to, and the engineer's name, system of distribution and voltage has been included. This is in itself a valuable feature, and typical of the enterprise shown in maintaining the high standard of the work.

BOOKS RECEIVED.

A Travers la Matiere et l'Energie. By Dr. F. E. Blaise. Paris: Librairie Ch. Delagrave. 344 pages, 68 illustrations. Paper cover. Price, 12 francs.

Les Tramways Electriques. By Henri Marechal. Paris: Ch. Beranger. 328 pages, 188 illustrations. Price, 10 francs.

Elementary Electricity and Magnetism. An Elementary Book on Electricity and Magnetism and Their Applications. By Dugald C. Jackson and John Price Jackson. New York: The Macmillan Company. 482 pages, 358 illustrations. Price, $1.40.

Electric Power Transmission. A Practical Treatise for Practical Men. By Louis Bell, Ph.D. Third Edition, revised and enlarged. New York: Electrical World and Engineer. 632 pages, 21 plates, 285 illustrations. Price, $3.

The Beacon Biographies. Samuel F. B. Morse. By John Trowbridge. Boston: Small, Maynard & Co. 134 pages, frontispiece portrait. Price, 75 cents.

L'Annee Electrique. Electrotherapie et Radiographie. By D'Foveau de Courmelles. Paris: Ch. Beranger. 430 pages. Price, 3½ francs.

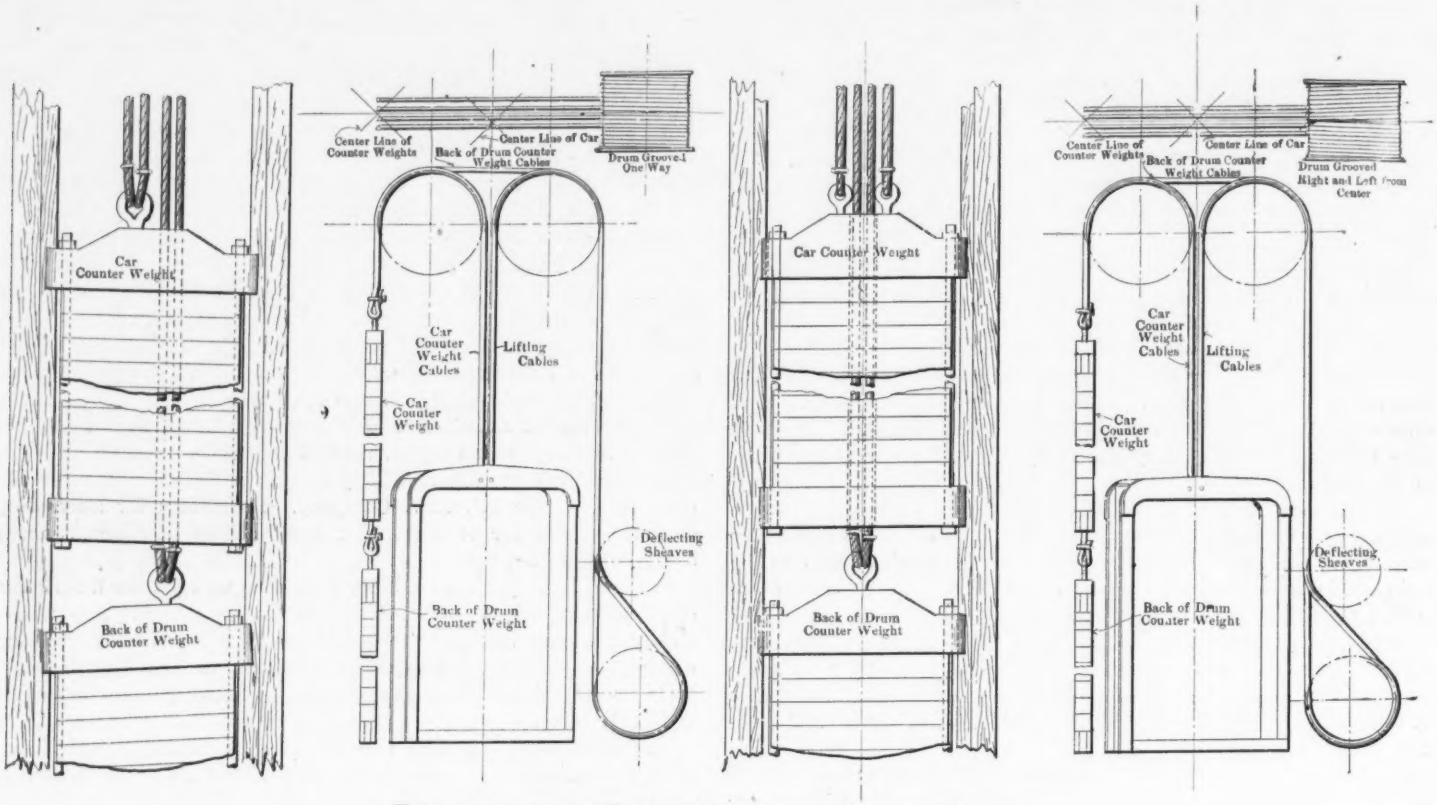
## A New Arrangement of Counter-Balance for an Elevator Car.

By Frank B. Kleinhans.

The usual arrangement of counter-balance for an elevator car is shown in Fig. 1. The cables from the car are attached to the top weight, while those from the back of the drum are led through cored slots in the top and attached to the lower weight, as shown. Half the distance between the center lines of the eye bolts is the distance of the center of gravity of the weight from the line of the cables. The result is that the weight sags on the heavy side, somewhat as shown in Fig. 1. The guide thus soon becomes badly worn. Fig. 2 shows the overhead arrangement of the sheaves and cables, and also the grooving of the drum.

Fig. 3 shows a new arrangement of counter-balance. It will be noticed that the car counter cables are separated and fastened to individual eye bolts at equal distances from the center of gravity of the weight; while the back of drum counter cables pass through cored slots in the top, and are fastened to the lower weight by an eye bolt in a line of the center of gravity. There will thus be no tendency for the weights to tip over, and consequently undue wearing away of the guide will be done away with.

The arrangement of the overhead sheaves and cables and the grooving of the drum are shown in Fig. 4. Here it is seen that the grooving of the drum is right and left hand from the center, while in Fig. 2 it is grooved in one direction all the way across the face. It is also seen in Fig. 2 that the center of the drum, car, counter-


Car Counter Weight
Back of Drum Counter Weight
Center Line of Counter Weights
Center Line of Car
Back of Drum Counter Weight Cables
Drum Grooved One Way
Car Counter Weight Cables
Lifting Cables
Car Counter Weight
Deflecting Sheaves
Back of Drum Counter Weight
Car Counter Weight
Back of Drum Counter Weight
Center Line of Counter Weights
Center Line of Car
Back of Drum Counter Weight Cables
Drum Grooved Right and Left from Center
Car Counter Weight Cables
Lifting Cables
Car Counter Weight
Deflecting Sheaves
Back of Drum Counter Weight

Figs. 1, 2, 3 and 4.—Counter-Balance for Elevator Cars.

weight and sheaves are not on the same line. A happy medium must thus be struck, in locating the overhead beams and sheaves, the counter-weight being pulled out of center one way, and the car the other. In Fig. 4 the centers are all on the same straight line, and all the parts will therefore be balanced.

## Paragon Fans for 1902.

The record of the Paragon fan for 1901 made it unnecessary to incorporate any radical changes in construction, and the only changes, therefore, in the 1902 model are an improved guard support on the desk trunnion and bracket fans, and an improved adjustment for the bracket and trunnion types. The new guard support consists of three radial arms secured to the body proper, while a fourth support is provided by the pedestal of the fan itself, thus making an attachment of such rigidity that the complete fan can be suspended or carried from the guard itself without straining it in the least.

The searchlight type of trunnion and bracket fan is retained, a new adjustment being added of such construction that the device

does not rely upon the friction between the fork and body to retain the fan in position; but, instead, the clamping screw is given such a position that a very slight friction or tension upon it secures the fan readily in any desired position. This is accomplished by placing the screw at a distance from the center about which the fan pivots.

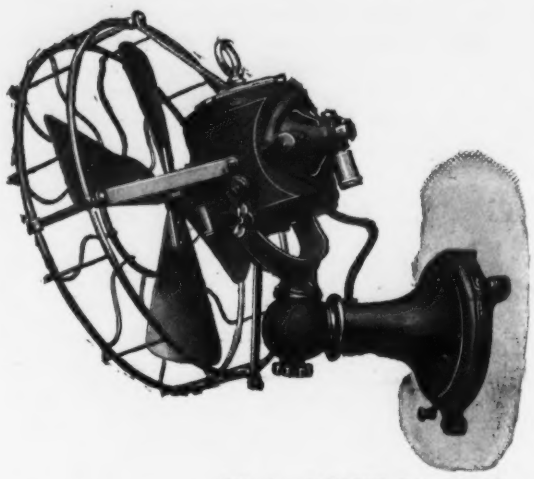
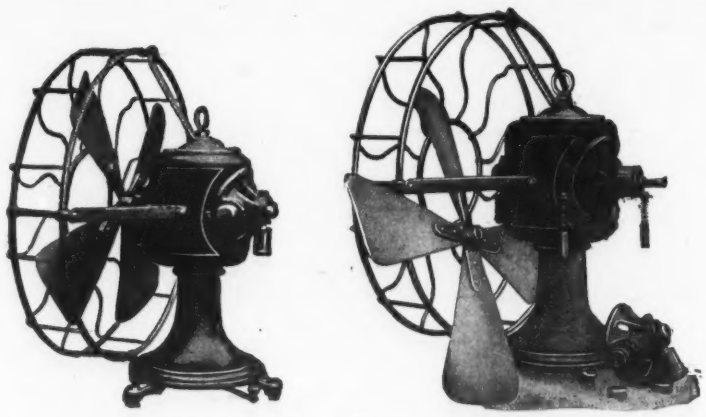


FIG. 1.—PARAGON FAN MOTOR.

The same excellence of material and workmanship, as has given the Paragon apparatus its present reputation, is maintained, and its manufacturers, the General Incandescent Arc Light Company, of New York, have retained such important features as rectangular carbon brushes, enameled resistances, one piece magnetic circuit, and the retaining shield for the bearings to prevent the creeping of the lubricant on the armature. The current consumption remains as low as ever, while the speed has been slightly increased, so that the actual efficiency has been raised.



FIGS. 2 AND 3.—PARAGON FAN MOTORS.

## "Stab" Switch.

The "Stab" switch, shown herewith, has been designed particularly for series arc and incandescent lighting circuits. It is made of a thick fiber tube, which is held to the switchboard marble by the escutcheon *A* (Fig. 3). The escutcheon is of hard rubber and very neat in appearance.

The circuit is closed by inserting a rod connecting the front terminal and rear terminals, *D* and *D*¹. Withdrawing the rod to open the circuit allows the little marble ball *B* to drop out of its tube *C* into the main tube of the switch, smothering any arc that may form. In closing the circuit, the rod which is pointed, pushes the marble ball up into the tube *C*. When on open circuit the rod is supported on the fork shown in Fig. 1.

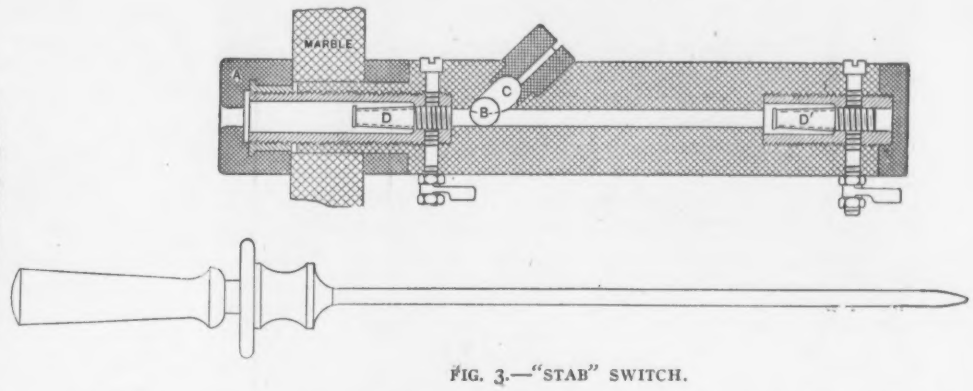
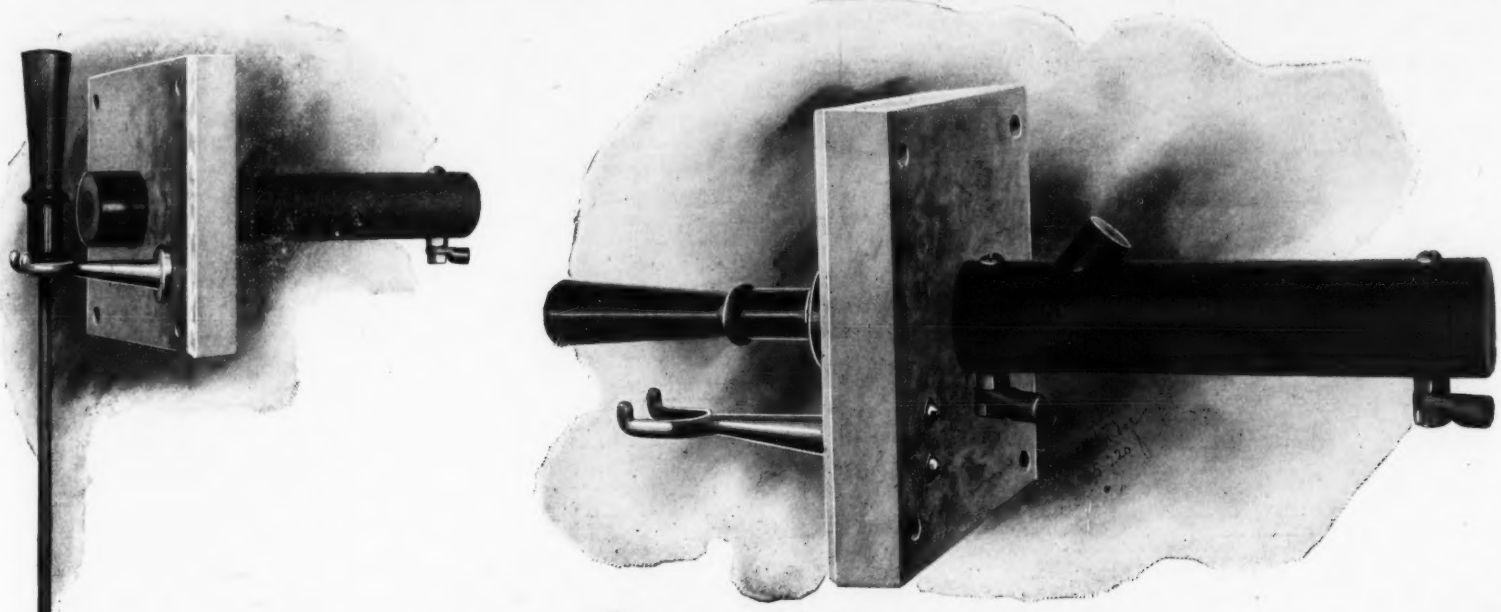



FIG. 3.—"STAB" SWITCH.



FIGS. 1 AND 2.—"STAB" SWITCH.

This switch operates satisfactorily at 6000 volts, and in its entirety is very neat and compact. It is readily removed from the marble by simply unscrewing the escutcheon. The manufacturers are the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

## A New Test Truck.

We illustrate an English testing cart, made by Elliot Brothers, London, which has been introduced especially for rapid localization of faults on large underground networks, a matter of the utmost importance in England in view of the stringent conditions contained in recent legislation and government regulations.

The apparatus consists essentially of a small portable battery, a standard resistance (usually 1 ohm), and a very accurate voltmeter of high resistance. An adjustable resistance is provided for keeping the battery current constant, as well as the necessary reversing and change-over switches, while an ammeter is usually included for the purpose of regulating the charge and discharge of the cells. The voltmeter, as a rule, has a maximum range of 10 volts, the same scale being used to read the current flowing through the standard resistance. The design is the result of a wide experience in cable work,

and embodies, it is believed, everything and no more than is necessary. The results obtained by careful observers in actual practice by this method are said to be wonderfully exact. In a test on a 2700-yard length of concentric cable, in which there was a "short" and also an earth of about 1000 ohms resistance, the fault was localized to 5 yards. This distance was the mean given by five tests, the greatest divergence from the exact position being only 10 yards.

TESTING CART.

Such accuracy as this is not always obtained, however, the more usual course being to open up the joint box nearest to the indicated position of the fault if the length is over 1000 yards and make a new test on a shorter length.

## The "Ideal" Engine Lathe.

An advance in engine lathes for general shop purposes has recently been placed on the market by the Springfield Machine Tool Company, Springfield, Ohio. This lathe has been designed to meet the demands of modern shop practice, being equipped in such a manner as to permit of effecting with dispatch all changes necessary for a wide range of feeds and screw cutting, and without removing any parts held by nuts and washers. A principal consideration was to have only such gears running as are necessary to transmit motion from the spindle to the lead screw, and although reverse gears have been added to the headstock, only seven gears are in operation when a right-hand thread is being cut, and eight for a left-hand thread.

All the change gears required on the lead screw have hub extensions on one side and revolve freely in brackets placed concentric in a disk, which disk is large enough in diameter to serve the purpose of a gear guard, since none of the gears, eight in number, is visible. The disk revolves on a stud secured to a case supended from the front lead screw box. By revolving the disk any of the gears, which, of course, are independent of each other, can be brought in line with the lead gear. This gear has a telescopically arranged extension controlled by a lever, which extension is reduced at its end to enter the hole of a change gear a distance equal to its width before the clutches with which the change gear and extension are fitted, come in contact with each other. It will thus be seen that when one of the change gears is connected with the lead screw it ceases to be supported by the disk, but is mounted on the screw as substantially as if it were secured to it by nut and washer.

As a sufficient range of feeds or screw pitches cannot be obtained by changing gears on the lead screws only, provision is made at the headstock for various ratios of speed. This is accomplished by means of three pairs of gears, contained in cases, which give ratios of 2—1, 4—1, 1—2, and 1—4, resulting in five different rates of speed for the fixed pinion which meshes with the intermediate gear transmitting the motion to the lead screw. The gears contained in this case are similar to those in the disk, and they are placed in position by slipping them on the reduced ends of the spindles, which are provided with clutches to engage them, and when in position for operation they are supported by the spindles instead of the cases, the only object of the latter being to facilitate handling and provide suitable guards. Since only one pair of gears can be used at a time, a receptacle is provided, as shown, in the leg of the lathe to receive the other pairs, where either is instantly available and can be placed in position in a moment.

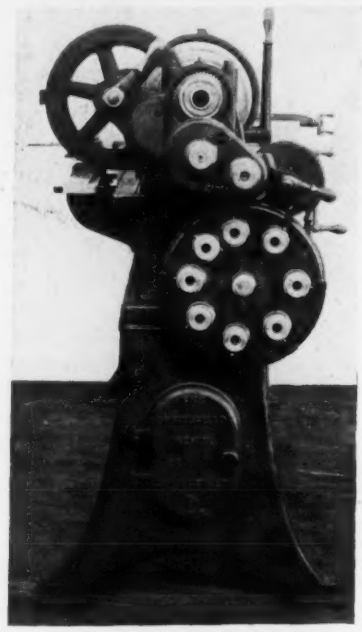


FIG. 1.—END VIEW OF LATHE.

The intermediate gear referred to above revolves in a fixed stud in a quadrant, as it requires no radial adjustment. The quadrant has a projection on its lower side, which is machined to the pitch radius of the intermediate gear, and as the same provision is made on the disk for each of its gears, it is only necessary to trip the intermediate gear until these surfaces meet, and then secure the same with a clamp lever.

The actual swing over the bed of the lathe is 17 inches, and the

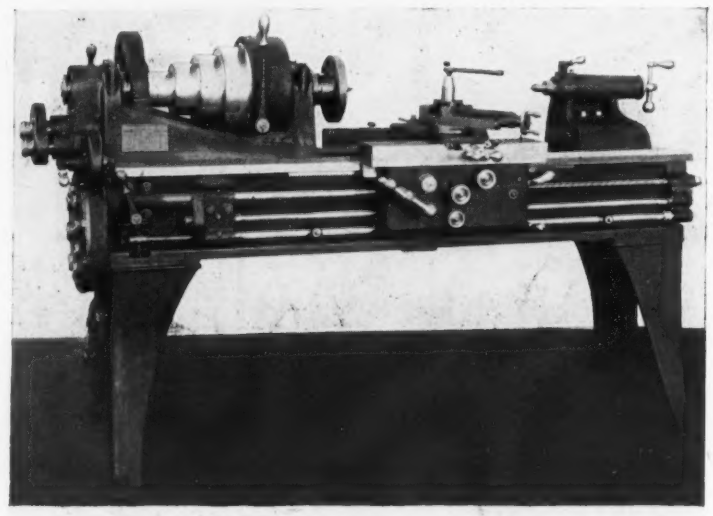


FIG. 2.—ENGINE LATHE.

range of threads that can be cut on the lathe is from 2 to 56 per inch, with a turning feed of from 8 to 224 per inch. Every change required to cut any of the threads or feeds between the extreme limits can be made when the lathe is in motion.

The reversing mechanism is of a type which does not require the use of a reversible countershaft for screw cutting purposes. This adjunct is controlled at the apron and is thus very convenient. Its

gears are placed between the end of the headstock and the apron secured to it, and are driven by a number of slip gears on the spindle, which may be slipped out of contact if no motion is desired. The reversible spindle engages the former or backing gears by means of a positive clutch actuated by the operator from his position in the front of the lathe carriage, by a lever suspended from the apron and sliding on a rod, to which it is keyed. This rod is connected to the clutch by suitable mechanism, and also serves the purpose of an automatic stop for either right or left-hand motion, both in turning or screw cutting. The frictions are susceptible of ample and convenient adjustment for wear, and will prove efficient during the life of the lathe. The spindle is hollow, made of hard, hammered crucible steel, and provided with journals of large diameter revolving in self-oiling bronze boxes.

## Independent Telephone Association of Wisconsin.

The convention in Milwaukee of the Independent Telephone Association of Wisconsin is reported to have been a very successful one, about 100 local associations being represented. The election of officers resulted as follows:

President, Richard Valentine, of Janesville; vice-president, H. G. Slater, of Waupaca; secretary-treasurer, H. C. Winter, of Madison. Executive Committee: C. W. Twining, of Monroe, first district; T. H. Sweet, of Fond du Lac, second district; J. C. Harper, of Madison, third district; William Lohmiller ,of La Crosse, fourth district; B. R. Lewis, of Rhinelander, fifth district; Captain John M. Baer, of Appleton, sixth district; Senator Gaveny, of Arcadia, seventh district; H. H. Stewart, of West Superior, eighth district; W. J. Bell, of Baraboo, chosen as a member of the committee-at-large.

It was decided to hold the summer meeting at Waupaca some time in June next in connection with the Northestern Electrical Association, and to hold the next annual meeting in Milwaukee, Feb. 3, 1903.

Mr. R. A. Tompkins, president of the Illinois State Telephone Company, addressed the delegates with regard to telephone conditions in Illinois. The following papers were read:

"The Proposed Contract of the Wisconsin Telephone Company," by Judge Gainor; "Possibilities of Association Effort," by E. B. Fisher, Grand Rapids, Mich.; "Bridging Magneto Bells," C. W. Farr, of Chicago; "Transmitters," by the representative of the Eureka Electric Company; "Telephone Cables and Their Construction," R. B. Abbott, Chicago; "Telephone Construction and Material," H. R. Ritter, Madison.

## Two Telpherage Plants.

The variety and magnitude of the work to which telpherage is now being applied is quite surprising, and yet not so surprising when one

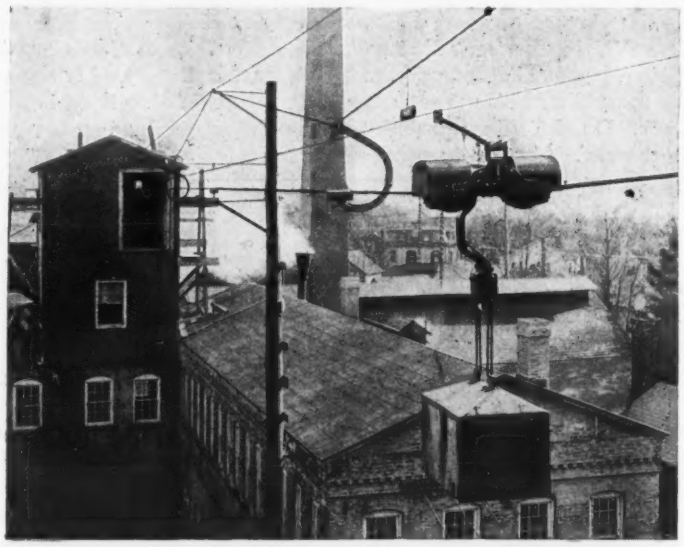


FIG. 1.—TELPHER LINE IN SAW MANUFACTORY.

considers how readily this means of transportation lends itself to the haulage of freight of every character. The United Telpherage Company, of 20 Broad Street, New York City, has not only been called upon to construct plants for the most widely different classes of work, but has had to deal with obstacles and difficulties which were such that nothing but the handy little telpher traveling along its aerial track was able to overcome.

Two recent plants illustrative of separate branches of the work are here illustrated. One of the cuts shows a factory in New England in which the telpherage line runs from one building to the other. The system is worked automatically with a switch at either end. The telpher box is conveying saws in a water-proof carrier. The line

FIG. 2.—TELPHER LINE IN FACTORY ON NEW YORK WATER FRONT.

has a sustaining capacity of 1200 lbs. It is 50 ft. from the ground, and current is supplied at 250 volts.

The other plant here illustrated is in the vicinity of New York City, and is employed for handling ashes and refuse along the water front. Work of this kind suits the telpher plan admirably. In this instance, the plant has a capacity of getting out 150,000 lbs. of ashes in 10 hours. As will be noted, the telpher hauls a trailer, and the average energy consumed is 1 hp. At the present moment, the line is handling the ash output of 23 boilers, as well as other refuse. The elevated position of the telpher line permits the material to be dumped into the center of a barge, thereby obviating entirely the employment of labor to distribute and level, which was necessary when dump carts were used.

## Mechanically-Operated Reversing Switch for Electric Motors.

Incidental to the design of automatic motor starters for elevator and similar service, a problem to be overcome is the destructive arcing caused by the discharge of the shunt field which invariably occurs when the combination of field and armature is broken. This arcing not only rapidly destroys the contacts of the switch, but also produces a dangerous strain on the windings of the motor, which fre-

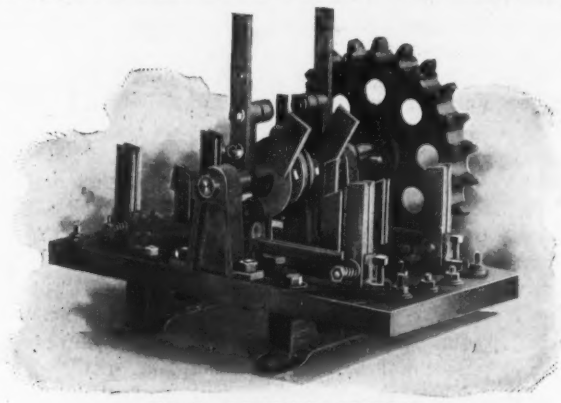


FIG. 1.—REVERSING SWITCH.

quently results in breaking down the insulation. In an effort to protect the insulation, it has been common practice to place across the field terminals a resistance to receive the discharge when the switch is opened, but this method was only partially effective.

The switch illustrated herewith is designed to completely over-

come these defects. This is accomplished by separating the parts which are used for making up the combination of field and armature from the main line switch, and mounting these independently. The throwing of the main line switch in either direction sets the combination which determines the direction of rotation, but the return of the switch to the center point does not disturb the combination thus selected; when the switch is thrown to the reverse position, a new combination is effected just prior to the entrance of the main line contacts. As the usual brake mechanism for stopping the armature will have set at or near the center of the switch throw, there will be no discharge from the field in reversing.

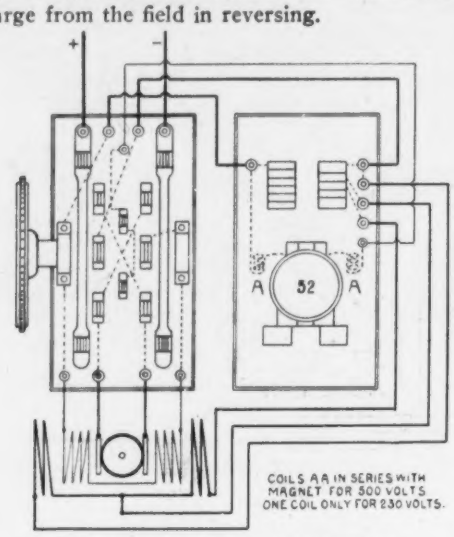



FIG. 2.—DIAGRAM OF CONNECTIONS.

Usually reversing switches are used on elevator motors which require heavy starting torque. To secure this, the motor is provided with one or more series coils, and it has always been necessary to carry the current through these coils before entering the switch, so that the direction of the current in both series and shunt fields would be the same. This resulted in keeping one side of the main line always connected to the motor. The present switch completely separates both sides of the line from the motor, as will be seen by an examination of the accompanying diagram of connections (Fig. 2).

As most of the wear comes on the main line contacts, these are readily and cheaply renewable, the blades and clips being easily detachable, and of simple form. The contacts may be removed and replaced without tools. All parts are interchangeable and are assembled by jig. This switch, which is made by the Automatic Switch Company, New York, is adapted for use with either shunt, series or compound wound motors, not exceeding 600 volts.

## New Lathe.

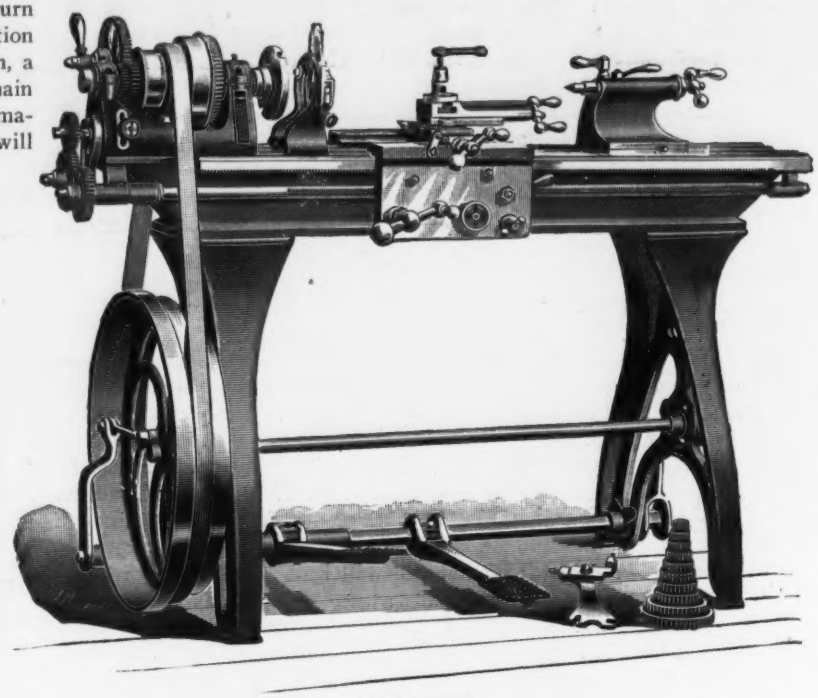
We show in the accompanying cut one of the latest types of "Star" foot lathes, adapted for repair shops, experimental and model work. These lathes are made in varying sizes, ranging from 9-inch swing, 24 inches between centers, up to 13-inch swing, 66 inches between centers, and are mounted on curved legs, when furnished with foot power, and on straight legs for shop use with countershaft, and on an oil pan for tool room use.

The head stock has a hollow spindle made from a crucible steel forging, running in long phosphor bronze bearings with an improved end thrust ball bearing. The tail stock is of improved curved pattern, which allows the compound rest to swing around parallel with the ways and over the base of tail stock with room to operate feed screw handle. The tail stock spindle is ararnged with self-discharging center and improved locking device, an adjustable side movement is provided for turning tapers.

The carriage has a long bearing on the ways, and is gibbed to bed both front and rear. It has interchangeable plain and compound rests with graduated base for making fine adjustments. The improved tool post collar and shoe excludes all dirt and chips and admits of a quick, easy and secure adjustment of the tool.

The automatic cross and longitudinal feeds are actuated by a phosphor bronze worm on the lead screw, which is splined. For all work except screw cutting it simply acts as a feed rod, and, therefore, the only wear on its threads is in screw-cutting. The feed may be thrown in or out of contact by simply moving a lever, and will feed in or out, right or left, and cut screws right or left. All standard threads from 3 to 64 can be cut without compounding the gears, and nearly all threads by compounding them.

The patent foot power consists of two treadles, with a walking motion. It can be started or stopped instantly, and may be operated



NEW LATHE.

with both feet sitting or one foot standing. When desired, a friction countershaft is furnished in place of the foot power.

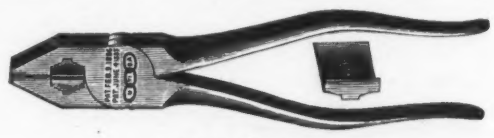
The "Star" lathes are made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y., U. S. A.

## Indiana Automobile Show.

The first annual automobile show given by the Indiana Automobile Association was opened in Indianapolis on Feb. 17. The exhibits are more extensive and the decorations more attractive than was expected. It is the purpose of the association to hold annually an automobile and bicycle show. Tests of climbing power will be made every day and evening by the various machines. The following companies and firms have exhibits at the show: Kokomo Rubber Company, Habbiek & Co., Indianapolis; Fisher Automobile Company, Indianapolis; Mueller & Co., Indianapolis; National Vehicle Company, Indianapolis; G. W. Westing, George Deitch & Co., Indianapolis; Haynes-Afferson & Co., automobiles, Kokomo; H. F. Hearsey, Vehicle Company, Indianapolis; Snyder Bicycle Company, the Union Automobile Company, of Union City, and many other out-of-town exhibitors. Tests of power and speed will be made during the week. On Feb. 18 automobilists from all over the State made a run to the city.

## Lineman's Pliers.

We illustrate below one of the latest specialties of the Smith & Hemenway Company and the Utica Drop-Forge & Tool Company, consisting of a side-cutting plier, known by the trade name "Royal Blue." It is forged from the best tool steel, and made with reversible and renewable jaws, thereby saving considerable expense to the



LINEMAN'S PLIERS.

user, as it allows the changing of jaws from the upper to the lower, when they become worn. It has, also, rounded corners and sides. This plier is of great advantage to a lineman, because when worn out or chipped in the corner next to the joint, the ordinary plier is useless, while this one by changing or reversing the jaws is made practically new at no further cost.

# NEWS OF THE WEEK.

## Financial Intelligence.

THE WEEK IN WALL STREET.—There was a fair demand for time money, and the supply was very good, the rates being 3½@4½ per cent for 30 to 60 days, and 4@4¼ per cent for longer arrangements. In the stock market there was a general decline of values on Thursday on the announcement of proceedings by the Government to annul the Northern Securities deal. Liquidation by timid holders was general, although the declines were checked by the support from large financial interests. The steel stocks showed strength on reports that the preferred stock will be retired by an issue of 5 per cent bonds. This, however, is now denied. Amalgamated Copper was firmer on short covering and better reports about copper trade conditions. In the traction list the operations were somewhat curtailed in Metropolitan Street Railway, the sales aggregating 56,750 shares, closing at 168⅝, which is a decline of about 3 points. Brooklyn Rapid Transit was also quiet, sales aggregating 27,280 shares, the closing price being 61¾, a net decline of 1 point. The sales of General Electric were 2900 shares, the prices ranging between 288 and 292⅜, the former figure being the closing quotation, which represents a net loss of two points. Western Union closed at 90½—a fractional decline—and Westinghouse, common and preferred, closed at 174 and 180, respectively. Other closing quotations are: American District Telegraph, 33, and American Telegraph & Cable, 90. The closing quotations of Tuesday, Feb. 25, are as follows:

NEW YORK.

| | Feb. 18. | Feb. 25. | | Feb. 18. | Feb. 25. |
|---|---|---|---|---|---|
| American Tel. & Cable.... | 91 | — | General Electric..... | 290 | 293 |
| American Dist. Tel..... | 30 | — | General Carriage..... | ⅞ | ⅞ |
| Brooklyn Rapid Transit.. | 62¾ | 64½ | Hudson River Tel..... | — | — |
| Ches. & Pot. Telephone.. | — | — | Metropolitan Street Ry... | 171⅛ | 168¼ |
| Commercial Cable..... | 155 | — | N. E. Elec. Veh. Tran... | — | ½ |
| Electric Boat..... | 26½ | 28½ | N. Y. Elec. Veh. Tran... | 13½ | 13½ |
| Electric Boat pfd..... | 45 | 45 | N. Y. & N. J. Tel..... | — | — |
| Electric Lead Reduc'n.... | 1¾ | 1⅝ | Tel. & Tel. Co. America.. | 4½ | — |
| Electric Vehicle..... | 2 | 1¾ | Western Union Tel..... | 90⅞ | 90¾ |
| Electric Vehicle pfd..... | 4¼ | 4½ | West. E. & M. Co..... | 174 | 177 |
| | | | West. E. & M. Co., pfd.. | 175 | 180 |

BOSTON.

| | Feb. 18. | Feb. 25. | | Feb. 18. | Feb. 25. |
|---|---|---|---|---|---|
| Am. Tel. & Tel..... | 158 | 157¼ | Mexican Telephone..... | 2 | 2 |
| Cumberland Telephone... | — | — | New England Telephone* | 140½ | 140 |
| Edison Elec. Illum..... | 257 | — | Westinghouse Elec..... | *90 | 87½ |
| Erie Telephone..... | — | — | Westinghouse Elec. pfd.. | 90 | — |
| General Electric pfd..... | 292 | 292⅜ | | | |

PHILADELPHIA.

| | Feb. 18. | Feb. 25. | | Feb. 18. | Feb. 25. |
|---|---|---|---|---|---|
| American Railway.s..... | — | 64½ | Phila. Traction..... | — | 100 |
| Electric Storage Battery.. | — | — | Philadelphia Electric..... | — | 4¼ |
| Elec. Storage Batt'y pfd.. | — | — | Pa. Electric Vehicle..... | — | — |
| Elec. Co. of America.... | — | 6¼ | Pa. Elec. Veh. pfd..... | — | — |

CHICAGO.

| | Feb. 18. | Feb. 25. | | Feb. 18. | Feb. 25. |
|---|---|---|---|---|---|
| Central Union Telephone. | — | — | National Carbon pfd.... | 83 | 83½ |
| Chicago Edison..... | — | 163 | Northwest Elev. com..... | — | 37½ |
| Chicago City Ry..... | 210 | 216 | Union Traction..... | 15⅝ | 13½ |
| Chicago Telep. Co..... | — | — | Union Traction pfd..... | 48½ | — |
| National Carbon..... | 20½ | 19¼ | | | |

*Asked.

NATIONAL CARBON ANNUAL REPORT.—The National Carbon Company reports for the year ended Jan. 31, 1902, as follows:

| | 1902. | 1901. | Changes. |
|---|---|---|---|
| Net earnings ..... | $586,812 | $508,739 | Inc. $78,073 |
| 7 per cent on pfd.. | 315,000 | 315,000 | |
| Balance . ..... | $271,812 | $193,739 | Inc. $78,073 |
| Depreciation ..... | 214,461 | 150,000 | Inc. 64,461 |
| Balance . ..... | $57,351 | $43,739 | Inc. $13,612 |
| Doubtful accounts. | 3,282 | 1,456 | Inc. 1,826 |
| Surplus ..... | $54,069 | $42,283 | Inc. $11,786 |

It is reported from Chicago, where the stock is listed, that National Carbon has been active on the local exchange of late on rumors that the common might be put on a 4 per cent basis. There is $5,500,000 common and $4,500,000 preferred stock. Dividends of 1¾ per cent quarterly have been paid regularly on the preferred since the second quarter in 1900. During last two weeks the common issue as a result of the bullish rumors, jumped four points, from 18 to 22. The preferred has been steady, ranging around 85 since 1899. The buying of Carbon stocks by Cleveland and Chicago investors has been regarded as good. The officials have not denied the report that the common will be put on a 4 per cent basis.

CLEVELAND TROLLEYS.—The bankers' committee of the Everett-Moore syndicate issued the following official statement concerning the sale of the "Big Consolidated" Street Railway system of this city: The deal for the Everett-Moore holdings of stock in the Cleveland Electric Railway Company has been practically closed. A syndicate headed by Horace E. Andrews has contracted for the entire holdings of stock of the Everett-Moore syndicate in the company. The price at which the stock will be sold is $80 a share. The Elkins-Widener-Dolan syndicate, which was negotiating for the property, failed to make a proposition satisfactory to the committee. Mr. Andrews and his associates are also large holders of the stock of the Cleveland City Railway Company, of which Senator Hanna is president. It is understood to be the purpose of those interested in the two companies to effect a consolidation, putting every street car line in the city under one control. The sale of the Big Consolidated will, it is said, in a great measure relieve the situation which forced the Everett-Moore syndicate to ask assistance of the bankers' committee. The sale of the stock at 80 returns to the holding members of the syndicate their equities in the Big Consolidated. With the collateral trust plan in full operation to relieve the telephone situation, it is believed the syndicate will practically be in shape to go ahead and conduct the affairs of its numerous other interests as formerly.

AMERICAN HOME TELEPHONE COMPANY.—Messrs. C. D. Knapp, Jr., & Co., New York City, offer $311,000 of the American Home Telephone Company's collateral trust 4 per cent bonds. The 10 constituent companies are operating "independent" telephone exchanges in various cities and towns in New York, Ohio, Indiana and West Virginia and their operations during 1901 showed net earnings of $59,093.04, with an increase during the year of 2337 telephones. The consolidation is expected to secure increased economy in management, long distance connections and the prosecution of an aggressive policy for the benefit of all the companies. The obligation of the company secured by deed of trust to the American Trust & Savings Bank, Chicago, is stated to equal in value 35 per cent more than the amount of bonds issued.

DENVER TROLLEYS.—It is alleged but also denied that negotiations which have been pending for some time involving the sale of the Denver City Tramway Company to the Morgan-Ryan-Widener-Elkins syndicate for $8,500,000, have been completed practically. The Denver City Tramway Company owns 150 miles of track, covering 88 miles of streets of Denver, including the former holdings of the old tramway company, the Metropolitan Street Railway Company, the Denver Consolidated Tramway Company, the Denver City Railway Company, the West End Railroad Company, the Denver City Traction Company, and the Colfax Electric Company. The company is capitalized at $5,000,000, and has $5,837,000 in bonds outstanding.

PENNSYLVANIA ELECTRIC VEHICLE.—At the annual meeting of the stockholders of the Pennsylvania Electric Vehicle Company in Camden a statement was read showing the company's operations for the past year. Directors were reduced from 9 to 7. W. W. Gibbs withdrew his name both as director and president. Vice-President Herbert Lloyd will be president pro tem until the directors organize. The annual statement ending Dec. 31, 1901, shows:

| | |
|---|---|
| Value of property, vehicles, etc. ..... | $825,000 |
| Sales of vehicles for 1901 ..... | 88,000 |
| Loss during first six months of 1901 from cab service..... | 17,000 |
| Profit during second six months (about) ..... | 4,000 |

BIRMINGHAM (ALA.) BONDS.—Messrs. Ladenburg, Thalmann & Co. offer to investors at 101 and interest, the unsold balance of $3,750,000 first consolidated mortgage 5 per cent gold bonds of the Birmingham Railway, Light & Power Company, of Birmingham, Ala. These bonds mature July 1, 1951, or may be called at 110 after July 1, 1906, and are a first mortgage upon all the lighting plants and street railway systems in the county in which Birmingham is situated, subject to $1,250,000 outstanding bonds of the Birmingham Railway & Electric Company, secured by a first mortgage on one-half of the mileage of the street railway system, for the retirement of which a like amount of bonds are held in the hands of the trustee.

FEDERIAL TELEPHONE COMPANY.—Directors of the Federal Telephone Company have voted favorably on a proposition to issue $1,000,000 of new collateral trust bonds at once, to give the company working capital for proposed extensions, and a meeting of stockholders will be held as soon as possible to pass on the action of the directors. These bonds will probably be sold to Cleveland banks. The remaining issue of $5,500,000 of collateral trust bonds which are to go to the creditors under the plan approved by the bankers' committee, will be passed upon by the directors at a later meeting.

MINNEAPOLIS GENERAL ELECTRIC report for the year ended Dec. 31 shows gross $405,634 and net $213,852, an increase in net over 1900 of $47,099. The fixed charges were $107,615, leaving firm net $106,238, out of which $45,000 was paid in preferred dividends.

# Commercial Intelligence.

THE WEEK IN TRADE.—The severe weather conditions somewhat affected mercantile operations and hampered the movement of general merchandise and the products of industry. Specially good reports, however, come from the jobbers of the West and Northwest, while those from the South and Southwest are not so satisfactory, trade being quiet and not as good as last year. Iron and steel were active, strong and advancing, and the structural mills are sold ahead to September, but plate mills are well up with orders. Business in copper was very quiet, none whatever being transacted for consumptive account. Interest centered solely in the sparring of the speculators. The market declined about ½c. during the week, closing quotation being 12¼c.@12½c., spot to May, Lake; 12¼c. to 12⅜c. for electrolytic, spot to May; 12⅛c. to 12⅜c. for casting, same deliveries. The business failures for the week, as reported by *Bradstreet's*, numbered 228, as against 265 the week previous and 221 the same week last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Feb. 19: Antwerp—1 pkg. material, $20. Argentine Republic—3 pkgs. material, $52; 5 pkgs. machinery, $249; 61 pkgs. material, $1,930. British West Indies—29 pkgs. material, $599. British Guiana—2 pkgs. material, $54. British Possessions in Africa—9 pkgs. material, $451. British East Indies—308 pkgs. material, $6,493; 14 pkgs. machinery, $4,600. British Australia—362 pkgs. machinery, $46,849; 30 pkgs. material, $7,559; 1131 pkgs. wire, $2,820. Bristol—22 pkgs. machinery, $7,210. Barcelona—1 pkg. material, $15. Cuba—71 pkgs. $2,002; 10 pkgs. wire, $137. Central America—20 pkgs. material, $506; 1 pkg. manufactures of copper, $23. Corunna—20 pkgs. wire, $368. China—58 pkgs. material, $1,794; 1 pkg. machinery, $9. Chili —1 pkg. wire, $28. Dunkirk—64 pkgs. machinery, $700. Danish West Indies—1 pkg. manufactures of copper, $19. Ecuador—2 pkgs. machinery, $92; 2 pkgs. material, $15. Genoa—2 pkgs. material, $70. Glasgow—52 pkgs. material, $661. Hong Kong—2 pkgs. machinery, $420; 1 pkg. material, $21. Hamburg—1 pkg. machinery, $45; 67 pkgs. material, $2,735; 2 pkgs. manufactures of copper, $110. Japan —53 pkgs. material, $4,127; 70 pkgs. machinery, $2,840. Lisbon—402 pkgs. electrical railroad material, $21,253. London—9 pkgs. cable, $1,700; 115 pkgs. material, $2,583; 45 pkgs. material, $6,064. Liverpool—96 pkgs. machinery, $13,485; 228 pkgs. material, $9,383; 1176 pkgs. material, $62,510. Mexico—209 pkgs. material, $4,314; 17 pkgs. machinery, $6,271. Marseilles—9 pkgs. machinery, $700; 3 pkgs. material, $150. Manchester—35 pkgs. machinery, $2,563; 2 pkgs. ma terial, $17. New Zealand—8 pkgs. machinery, $1,120; 31 pkgs. ma terial, $1,747. Philippines—18 pkgs. machinery, $756; 3 pkgs. material, $100. Peru—13 pkgs. material, $207. Rotterdam—2 pkgs. material, $15. Siam—21 pkgs. material, $741. Sheffield—3 pkgs. wire, $269. United States of Colombia—2 pkgs. material, $58.

MACHINE TOOLS FOR JAPANESE ARSENAL.—The Japanese Government arsenal now under construction at Maizuru is to be equipped with some 40 American labor-saving devices which will represent an expenditure of about $35,000. The contract, the major portion of which was closed through the Japanese house of Takata & Co., 10 Wall Street, New York City, is said to constitute the most important lot of American specialties of the description ever called for by the Japanese authorities. Manning, Maxwell & Moore, of 85-89 Liberty Street, have had orders placed with them for two large engine lathes and one big double punch and shear, which are to be built by Hilles & Jones, of Wilmington, Del. The American Tool Works Company, of Cincinnati, Ohio, will furnish seven of its specialties, comprising drill press, radial drill, iron planer and engine and gap lathes, the latter fitted with compound rests. The Hendey Machine Company, of Torrington, Conn., is to manufacture three large lathes fitted with compound rests. The Bradford Machine Tool Company, of Cincinnati, Ohio, will also forward four of its big lathes. The Riehle Brothers Testing Machine Company, of Philadelphia, is to supply an automatic and autographic testing machine fitted with screw beam, and having a capacity of 50,000 lbs. A tool grinder order is to be executed by Gould & Eberhardt, of Newark, N. J. The J. A. Fay & Egan Company, of Cincinnati, Ohio, is to build five machines, consisting of pattern makers' lathes, surface planer, band sawing machine and a mortising and boring tool. The W. F. & John Barnes Company, of Rockford, Ill., has been allotted an order for a screw cutting lathe, a friction disk drill and an upright drill. The Lodge & Shipley Machine Tool Company, of Cincinnati, Ohio, is to supply a large engine lathe with compound rest. Further orders are about to be placed for screw machine automatic bolt cutter lathe, with compound rest, milling machine and a set of twist drill grinders.

VARIOUS C & C ORDERS.—The C & C Electric Company, of Liberty Street, New York, reports receipt of an order for an 80-hp slow-speed motor to be shipped to South America. The company's domestic orders secured during February include one for 15 motors varying in size from 2 hp to 20 hp, to be utilized for the direct driving of fans and blowers in the New Mount Sinai Hospital, New York. Two 75-hp slow-speed motors (making the third order) have been requisitioned for by the William J. Moxley Company, of Chicago, Ill. A 50-hp motor and a 75-hp one are to be shipped for installation in a manufacturing plant at Ossining, N. Y. One 75-kw direct connected generator has been ordered for a Philadelphia apartment house. Joseph S. Champion, of Atlantic City, has sent in an order for a 50-kw and a 35-kw direct connected generator to serve as lighting equipment in a hotel at that New Jersey resort. The Standard Oil Company is to be furnished with a 60-hp slow-speed motor to be used for driving a well pump. Shoemaker & Co., of Philadelphia, have ordered a 40-kw direct-connected generator and six motors varying from 2 hp to 10 hp each for general use in machine works. The Hallenbeck, Wynkoop & Crawford Printing Company, of New York City, has called for a 20-hp series parallel equipment, which is to be used for driving a magazine press in that concern's new building, and a 65-kw generator, together with a 60-hp motor, has been ordered for irrigating purposes on a large Texas ranch.

MORE MACHINERY FOR GREAT NORTHERN STEAMSHIPS.—The two huge steamships, which are now under construction for the Great Northern Steamship Company at the yards of the Eastern Shipbuilding Company, New London, Conn., are to be equipped with a further lot of Westinghouse apparatus for electric lighting and ventilating purposes. As already mentioned in ELECTRICAL WORLD AND ENGINEER, Westinghouse, Church, Kerr & Co. were last fall awarded a contract for eight marine generating sets, consisting of Westinghouse compound engines of 150 hp each, to be direct connected to 75-kw generators. The order just placed calls for the supply of four more sets of the same description. The contract, as a whole, constitutes one of the most important ever let for marine electrical equipment. Its value is about $75,000. Several substantial contracts have yet to be decided upon for machinery to be installed in these vessels, which are being built for the Oriental trade. The large cargo conveyers are to be operated by electricity. The steering gears will be of the electrical tiller type, and the winches for handling cargo are also to be worked by motors. There will also be large ice machines of the ammonia compressor type, which will be operated electrically.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, Ill., have just closed a contract with the Case County Telephone Construction Company, of South Bend, Ind., for a central energy "major relay" type switchboard of 4000 lines' capacity, with a possibility of 7200 lines. Its present capacity will consist of 1500 lines. Included in this contract is all necessary power apparatus, arresters, frames, etc., and 1000 standard central energy telephones; a toll board of 50 lines' capacity, with a present equipment of 25 lines. The local company intends making this one of the most important toll lines in the West, giving service direct from Chicago to New York. At present the company will install 1000 telephones, and additional instruments will be delivered as required. The outside construction in general will be first class in all respects. All of the downtown district will have an underground conduit system. The Kellogg Switchboard & Supply Company also report having been awarded a contract for an extension on the Logansport, Ind., exchange before it was completed and ready for operation, which proves the satisfaction of the company with their switchboard, as well as their ability to secure favors from the citizens of Logansport.

IDAHO POWER DEVELOPMENT.—The Westinghouse Electric & Manufacturing Company, through its Western agent, Mr. L. M. Cargo, of Denver, has just closed a deal with the Boise-Payette River Electric Power Company, whereby it will furnish a complete generating power plant of 2500-kw generators direct connected to two 1100-hp Leffel turbines, including 26 miles of pole line to Boise and the two mining camps of Pearl and Neal. This plant will furnish energy for lighting and power of all kinds at these places. The contract price is $60,000. This is the largest electric contract made in Idaho, aside from the recent contract with the Short Line for the new shops at Pascatello. The pole line will be up in 60 days, and the plant itself will be ready for operation Oct. 1. Miles & Blanchard is the Boston firm backing the Idaho power corporation and floating its bonds.

NORTHERN ELECTRIC MANUFACTURING COMPANY, of Madison, Wis., is to supply generator capacity for a new 750-hp plant, put in by the Massillon (Ohio) Iron & Steel Company.

CANADIAN NIAGARA POWER EQUIPMENT.—A memorandum, prepared for Mr. J. W. Langmuir, chairman of the commissioners for the Queen Victoria Niagara Falls Park, Ont., shows the following details of work done, and contracted to be done, and machinery purchased by or on behalf of the Canadian Niagara Power Company: Conduit, cable and electrical machinery, for use during construction, purchased at a cost of $20,664; wheel pit excavation, $19,150; tunnel and shaft—the shaft has been completed and the tunnel driven 200 ft. under a contract which calls for an expenditure of $513,000; cofferdam, materials purchased, at a cost of $27,000; contract for cofferdam, $23,000; wheel pit and in-take canal, over $500,000; bridge across canal opening, $55,000; transformers, generators, exciters and switchboards, viz., contract let for nine transformers for proposed transmission to Toronto and elsewhere, $43,200; contract also let for three 10,000-hp generators, $209,475; contract authorized for exciters, etc., to cost $16,000; contract also authorized for switchboard, $75,000; turbines—contracts made for plans of 10,000-hp turbines, the plans and license fee involving a cost of $10,000. Upon receipt of these plans the company is authorized to order three 10,000-hp turbines at a cost of $130,000; land purchased adjacent to park and laid out for manufacturing sites and an industrial village, $75,000, making the total expenditures at present undertaken for this power plant at $1,716,489.

ANOTHER ELECTRIC ROAD FOR MEXICO.—The City of Mexico is to have another electric traction system. Advices from that part of the world state that a concession has been granted to an enterprise styled the Mexican Traction Company, of which John L. Moylan is president, for the purpose of building and operating an electric traction system to run between the Mexican capital and Tacubaya, one of its suburbs. The length of the road will be about 8 miles. The company absorbs the project of Senor Miranda y Marron, who, in 1898, was granted a franchise with a view to connecting the eastern part of the city with Tacubaya, but who only constructed a small portion of the line. The new company will be permitted to import equipment from the United States free of duty. Ninety-pound rails are to be used. The whole system must be built inside of 18 months.

PHILADELPHIA DEPARTMENT STORE.—The contract for the electrical installation in the new addition to Gimble Brothers' store, Philadelphia, has been awarded to Kellar, Pike & Co., of the same city, who, it will be remembered, recently installed the electrical equipment in the new Philadelphia Mint, described in these pages Feb. 1. Gimble Brothers' store, when the present addition is completed, will be the largest department store in the world. The current is to be supplied by the Edison Company, and the new addition alone will require 750 arc lamps, and about 5000 incandescent lamps. The work throughout is to be installed in loricated conduit, of which 75,000 ft. will be required. The wiring will all be done on the three-wire system, requiring about 150,000 ft. of wire.

NEW COPPER FIELDS.—The office of the Chartered South Africa Company, in London, received the other day from its agents in north Rhodesia the report of the discovery of a new copper field estimated to cover 40 square miles. The field is about 150 miles north of Victoria Falls, near the border of the Congo Free State, and runs over into that territory. Mining engineers in the service of the company are now taking out ore which assays 44 per cent copper, besides a large percentage of silver. It is said that the company attaches so much importance to this discovery that the route of the Cape to Cairo Railroad will be diverted a considerable distance to the west in order to pass through the copper field. It is expected that this section of the railroad will be completed early next year.

CONTRACTS FOR POWER GENERATORS.—The Redlands (Cal.) Electric Light & Power Co. recently closed a contract with the General Electric Company for four 750-kw, three-phase generators, which are to be direct connected to impulse wheels operating under a head of 1900 ft. The contract calls for revolving field machines generating current at 750 volts with 430 r. p. m. There will be step-up transformers with 33,000 volts on the secondaries. The apparatus will be installed at the Mill Creek No. 3 power station, about 10 miles up the creek from Redlands. It is probable that the current generated there will be used East of Pomona. It all goes into the general transmission system of the Edison Electric Company, of Los Angeles, which controls a number of plants.

POWER PLANT FOR MAINE.—Further developments of electric power are projected for the vicinity of Lewiston, Me., and Libbey & Dingley, of that city, are in the market for the complete equipment for a new power house at Deep Ribs, 2 miles above Lewiston, on the Androscoggin River. A stone and concrete dam will be constructed, and the plant will be laid out for 10 direct-connected alternating-current generators of about 1200 hp each. Libbey & Dingley own the Lewiston & Auburn Electric Light Company, Auburn; the American Light & Power Company, and the Lincoln Mill and Cumberland Mill, in Lewiston, and part of this new power will be used in connection with these electric light and power interests.

WESTINGHOUSE EQUIPMENT FOR ENGLAND.—Over $40,000 worth of various equipment has just been shipped from the Westinghouse works at East Pittsburg for the Bournemouth (England) Corporation tramways, a substantial contract in connection with which was secured by the British Westinghouse Electric & Manufacturing Company, Limited. Owing, however, to the new Manchester works of the British Company not yet being able to execute orders, the major portion of the machinery in reference to the many other British contracts recently secured is being turned out at the American Westinghouse Company's plants.

STORAGE BATTERY PLANT.—Among the recent installations of the Gould Storage Battery Company is that of the Collier Publishing Company, Little West Twelfth Street, New York, which consists of 56 cells in lead-lined tanks. The present capacity is 194 kw-hours, with an ultimate capacity of 225 kw-hours. The installation includes switchboard and the Gould patented c. e. m. f. regulating booster, the size installed with this booster being 12 kw. The battery is used for regulating the fluctuating loads caused by very heavy presses, and also to act as a reserve in case of a breakdown.

CALIFORNIA POWER TRANSMISSION.—The California Power Company has appropriated water out of the Kings and Kaweah rivers in Tulare County, and nearly all of the available power-water of the Kern River and its tributaries for use on its electric transmission lines. A large generating plant will be installed on the Kern River near Kernville. The hydraulic work is already under way, and 8 miles of tunnels will be required to convey the water through the hills. Electric power will be transmitted to Los Angeles and other points in Southern California.

ELECTRIC CRANES.—It is stated that the Cleveland Crane & Car Company, of Cleveland, formed to manufacture electric cranes, have secured a site at Wickliffe, 10 miles east of Cleveland, and are preparing plans for a building 160 by 100 ft. All machinery will be electrically driven, and a number of heavy tools will be installed. The Cleveland Crane & Car Company is capitalized at $100,000, and the officers are W. D. Sayle, president; Charles E. Thomas, vice-president and general manager; A. L. Assmus, secretary.

THE MORGAN ENGINEERING COMPANY, Alliance, Ohio, has decided to go into the manufacture of blowing engines and traveling crane girders, and to that end it has been decided to erect a new plant for each class of work. Plans are being prepared and bids will be called for shortly. The blowing engine department will be in charge of M. Pettit, formerly with the E. P. Allis Company. It is expected that the new plants will be in operation before the end of next summer.

INSULATOR FACTORY REBUILT.—The plant of Mr. Fred M. Locke, of Victor, N. Y., which was destroyed by fire early in January last, has now been entirely rebuilt, the new plant being twice the size of the former one. With double the facilities, Mr. Locke will be able to turn out twice as many insulators as before. He is now operating a large portion of the plant, and is filling orders in good shape. He expects to have the new plant in full operation by March 15.

RAILWAY EQUIPMENT CONTRACTS.—The Muncie, Hartford City & Ft. Wayne Railway, for which E. P. Roberts & Co., Cleveland, are engineers, has placed contracts with the John Stephenson Company for eight 44-ft. passenger coaches, to be delivered July 1. Also for 50 miles of copper wire with the National Conduit & Cable Company, New York. Poles have been ordered and 25,000 ties are being distributed along the right of way.

MICHIGAN POWER PLANT.—On Feb. 20 the Michigan Hydraulic & Electric Company (Samuel S. Reed, engineer) was granted a franchise by the Board of Supervisors of St. Joseph County, Mich., to construct four dams on the St. Joseph River. The first to give a working head of 22 ft., the second of 14 ft., the third of 8 ft., and the fourth of 14 ft. These powers will be used for electric plants.

THE NORTH JELLICO COAL COMPANY is adding to its electric power plant at Gray's Station, Ky., a 175-hp engine built by the Ball Engine Company, Erie, Pa., and arranged for direct connection to a 100-kw General Electric generator furnishing the increased power. This is a duplicate of plant furnished a year ago.

NORTH ELECTRIC COMPANY.—The board of trade of Mt. Vernon has made an informal proposition to the North Electric Company, of Cleveland, to remove its factory to that town. The North Electric Company has outgrown its quarters in Cleveland, and is understood to be figuring on making a change.

TELEPHONES FOR HOLLAND.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has just made a shipment to Gereke & Co., of Amsterdam, Holland, of one 12-point Clark switchboard complete for their offices in that city.

LORAIN TRAMWAY RAILS FOR SCOTLAND.—The Lorain Steel Company, of Lorain, Ohio, has just made shipment of 110 tons of special rails for the Ayr (Scotland) Corporation electric traction system.

CONTRACTS FOR MEAD CONVEYING MACHINERY.—John A. Mead & Co., of Rutland, Vt., New York office in the Bowling Green Building, have obtained a substantial contract for an automatic railway to be used for handling coal in a large electric power plant at Milan, Italy. The engineering firm of Kerkhoven & Mazel, of Tjibadak, Dutch East Indies, has also ordered a quantity of conveying machinery. Domestic contracts lately allotted the Mead concern comprise an order, valued at some $60,000, for an electric cableway plant, which is to unload coal from vessels to storage and from there to cars at the C. Creiss Coal Company's plant, Sheboygan, Wis. This equipment will be operated by three motors of 100 hp capacity each. The new power station being built by the Chicago City Railway at Fifty-second Street and Wabash Avenue, Chicago, is to be equipped with a Mead coal and ash-handling plant of 45 tons capacity hourly. This plant is to be installed with eight 400-hp water-tube boilers built by the Babcock & Wilcox Company. The new additions to the Syracuse, Ind., electrical plant of the Sandusky Portland Cement Company, of Sandusky, Ohio, is to be furnished with some 750 ft. of coal and ash-handling equipment. The contract for the necessary electrical apparatus for the extension of the Indiana plant has been placed by the Westinghouse Electric & Manufacturing Company.

SHEDD FANS FOR EXPORT.—The Shedd Electric & Manufacturing Company, of Roselle, N. J., whose New York offices are in the Electrical Exchange Building, has just taken a fair-sized order for 12-inch oscillating electric fans to be forwarded to Buenos Ayres, Argentine Republic. The order was secured through the Federal Electric Company, of 141 Broadway. Carlo Pfaltz, of Genoa, Italy, has sent an initial order for fans of the same description. The firm of Preece & Cardew, in which Sir William Preece, formerly engineer-in-chief of the telegraph department of the London General Post Office, is a partner, is negotiating with the Shedd people with a view to the introduction of these fans into the various government offices in British India. The company is also figuring on an order for 150 fans, which are intended to be used in carriages on the French State railways, the fans to be operated from storage batteries. Orders just secured in Boston, Providence and Worcester represent a total of 500 fans, 100 having been ordered by the Union Hardware Company, of Providence, R. I.; 50 from Belcher & Lewis, of the same place, and 100 from Plummer, Ham & Richardson, of Worcester, Mass.

LARGE CONTRACTS FOR VIRGINIA PLANT.—The more important contracts for the electrical power plant of the West Virginia Pulp & Paper Company at Piedmont, W. Va., have just been determined on. The structural material for the building has been ordered from the American Bridge Company, the contract calling for some 500 tons of steel. The boiler plant of a nominal capacity of 6000 hp has been undertaken by the Edgemoor Iron Works, of Edgemoor, Del. It will consist of 10 units of 600 hp each. The generators will be two in number, and are to develop 800 kw each. There will also be some 20 motors, aggregating over 2000 hp. This portion of the contract has been awarded to the Westinghouse Electric & Manufacturing Company. John A. Mead & Co., of Rutland, Vt., will supply the coal and ash-handling machinery capable of handling 45 tons per hour. The power station's smokestack, to be built of perforated brick, will be an unusually large one, as it is to be 235 ft. high and 13½ ft. inside top. The plant, it is said, has been planned so as to permit of the capacity being considerably extended. Mr. T. G. Tenbroeck, of 136 Liberty Street, is acting as consulting engineer in the matter.

HEINE BOILERS FOR AUSTRALIA.—The Heine Safety Boiler Company, of St. Louis, Mo., whose New York offices are in the Bowling Green Building, reports recent receipt of a contract through the export house of Henry W. Peabody & Co., 17 State Street, New York City, for shipment of three 200-hp and three 250-hp boilers for installation in a South Australian electric power plant. Among the more important domestic orders secured within the last few weeks for Heine boilers is one requisitioning for six units of 500 hp each. These boilers are intended to serve as equipment for the new power station of the Philadelphia & Lehigh Valley Railway. The new Astor Hotel now under construction at Fifty-fifth Street and Fifth Avenue, New York City, is to be furnished with four boilers of 350 hp capacity each. This equipment will be utilized for light and general power purposes. The Pawtucket (R. I.) Electric Company has ordered two 350-hp boilers, and the Keystone Improvement Company, of Hazelton, Pa., has called for four boilers of 300 hp capacity each for electric railway use.

NEW YORK RAPID TRANSIT STEAM PLANT.—The contract for the condensing apparatus for the Rapid Transit Railroad power station has been awarded to the Alberger Condenser Company, 95 Liberty Street, New York. This is the largest contract ever given for a condensing apparatus, the total capacity of the outfit being 80,000 hp, comprised of eight units of 10,000 hp each. The type selected by the engineers of the Rapid Transit Subway Construction Company is the barometric condenser recently brought out by the Alberger Company. This is a jet condenser, and operates on the dry vacuum system. The water, circulating and air pumps are to be operated by cross-compound steam cylinders, with cranks and flywheels. The whole equipment is new and original in design.

BROWN CORLISS ENGINE COMPANY.—Woolston & Brew, of 39-41 Cortlandt Street, which concern for some time past has acted as New York manager for the Ball Engine Company, of Erie, Pa., has entered into arrangements with the Brown Corliss Engine Company, of Milwaukee, Wis., for the purpose of representing the interests of that Western concern in the Eastern territory, both for export and domestic trade. The Roosevelt Hospital authorities, New York City, have just ordered two 160-hp simple non-condensing Brown Corliss engines, which are to be direct connected to 100-kw generators to be supplied by the Westinghouse Electric & Manufacturing Company. This equipment will serve to light the hospital.

WHITNEY INSTRUMENTS ABROAD.—Machado & Roller, of 203 Broadway, report receipt of fair-sized orders from the British electrical engineering and contracting firm of Robert W. Blackwell & Co., Limited, also from the Japanese house of Takata & Co. These instruments are manufactured by the Whitney Electrical Instrument Company. The orders include recorders varying from 100 to 15,000 amperes. Some of these instruments are intended for use in London underground railway plants. An order has been obtained for a large wattmeter for the Utica (N. Y.) Electric Light & Power Company; and the New Orleans & Carrolton Street Railway, Louisiana, is to be furnished with a 15,000-ampere recorder.

GOUBERT HEATERS FOR ENGLAND.—The Goubert Manufacturing Company, whose offices are in the Singer Building, Broadway and Liberty Street, has been recently allotted an order for an 1800-hp feed-water heater to be installed in the British Westinghouse Electric & Manufacturing Company's works now under construction at Trafford Park, England. The Goubert people have just secured a contract (making the second) for two feed-water heaters of 4000 hp each, from the Edison Electric Illuminating Company, of Boston, Mass., which concern is at present placing considerable contracts in connection with the extension of its plant at Atlantic Avenue, Boston.

PHILADELPHIA BELL TELEPHONE.—At the annual meeting of the Bell Telephone Company, of Philadelphia, the directors were re-elected, the only change being James E. Mitchell, elected president in place of Frederick P. Fish. A resolution was adopted at the meeting to provide for the calling of a special meeting of stockholders on April 22 for the purpose of authorizing an additional issue of $4,000,000 stock. It was also decided to issue at once the $1,000,000 of stock now in the treasury. The increase in capital stock of $4,000,000, makes the total issue $12,000,000. The money is for extensions.

VITRIFIED CONDUIT FOR SOUTH AMERICA.—The American Vitrified Conduit Company, of Akron, Ohio, has just been awarded two South American contracts. One is for 500,000 ft. of vitrified conduit for telephone wires in Buenos Ayres, Argentine Republic. The other contract calls for 250,000 ft. for both telephone and electric light purposes in Chili. The American Vitrified people have been allotted the contract for some 3,500,000 ft. of conduit to be made use of in the New York Subway.

OPPORTUNITIES IN BOLIVIA.—Attention is again called in the organ of the Bureau of the American Republics to the opportunities for electric light plants, under advantageous conditions, in the Bolivian cities of La Paz, Cochabamba, Potosi and Sucre. Abundant water power exists for the purpose within convenient distances. Any person interested can ascertain particulars from Senor Guillermo Sanjines, chief clerk of the Department of Interior, La Paz, Bolivia.

STEAM PLANT WANTED.—The Weston, W. Va., Electric Light, Power & Water Company is in the market for two 125-hp water-tube boilers with stack and feed-water heater capacity for both boilers. The new plant is required immediately. Mr. J. S. Mitchell is secretary and superintendent.

EVANSTON, ILL., LIGHTING.—The Evanston and Yaryan Electric companies have been merged, and will expend $1,500,600 on improvements. These companies have been cutting rates for two years, and it is expected that the consolidation will result in better service, with increased rates.

LIGHTING EQUIPMENT WANTED.—The village electric light trustees of Martins Ferry, Ohio, wish to secure bids on an alternating-current incandescent generator with exciter, boilers, feed water pumps, etc.

E. W. BLISS COMPANY.—It is reported that plans are in process of formation for the absorption of the United States Projectile Company by the E. W. Bliss Company, of Brooklyn.

# Special Correspondence.

## ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, Feb. 15, 1902.

LAMPS FOR HIS MAJESTY.—The Edison & Swan United Electric Light Company, Limited, have received the honor of appointment by royal warrant as purveyors of electric lamps to the King.

LEEDS TELEPHONES BOULOGNE.—The use of the English-French telephone cable seems to be quite small. It is noted that the first message from Leeds to Boulogne has just been sent over it, "or in fact from any place in England except London." The distance is but 300 miles from Leeds, a busy English city, to Boulogne, so that the clearness of transmission cannot be regarded as remarkable.

A TUBE FOR THE TYNE.—A bill for authority to connect North Shields and South Shields on opposite sides of the River Tyne by means of a tube railway operated electrically will be brought up this session in Parliament. A single tube only is contemplated with a diameter of 13 feet. They propose to erect a generating station in South Shields, and the capital is proposed to be $900,000, and the time sought for the construction of the railway is five years from the passing of the act. The proposed rates for passengers are to be 4 cents per single journey in the first-class carriages, and 2 cents in the second-class carriages.

ELECTRICITY AND HYPNOTISM.—A remarkable cure by electricity and hypnotism is reported from Prague, where a certain Adolf Resch met with an accident which resulted in serious nerve shock and loss of the power of speech, besides partial idiocy. Dr. Jacksch, of Prague Hospital, had him electricized by a powerful current, and then hypnotized. While hypnotized he was told to speak and tell them his name. He answered correctly, though he appeared to speak with difficulty. Further questions were answered sensibly and with increasing ease, and finally when brought to the patient had regained the power of speech and the full use of his intellect.

THE KING'S COACH.—The King has ordered two more motor cars, which are being built at Coventry. His Majesty began his career as an automobilist with a six-horse-power Coventry-Daimler mail-phaeton; but this has now been given up on account of the seating arrangements. Of the two new cars now being built for the King, the pleasure-car, according to the *Court Journal*, is to have a 22½-horse-power four-cylindered motor (making 720 revolutions at normal speed), under single lever control. It is designed to carry petrol sufficient for 150 miles, and will be fitted with both tube and electric ignition. The motor is geared to twenty-four miles an hour. The second car on order is practically an omnibus, for it is designed for the transportation of luggage, servants, loaders, etc. The motor is 22 to 24 horse-power, with both tube and electric ignition, and is placed under a bonnet in front of the dashboard instead of being underneath the footboard, as in the car now in use.

ELECTRICITY AND CANALS.—This subject is beginning to attract some attention. As an indication of the interest which is now being taken in the subject, reference may be made to the significant speech of Lord Dudley, the Parliamentary Secretary of the Board of Trade, at the dinner of the Leeds Chamber of Commerce the other night. The Board of Trade, he said, cordially sympathized with the desire of the Chamber that the internal waterways of the country should be fully developed. An enormous boon would be conferred on many manufacturers, especially in the Midland districts, by such a cheaper system of carriage as canals might afford. He hoped that before long this matter would be seriously taken in hand and pressed upon the attention of Parliament. To amalgamate the canal systems into trusts would necessitate a large sum of money, and, so far as he knew, there were only three ways in which it could be found—by private enterprise, by Treasury grant or loan, or by loans from the local authorities.

TELEPHONE ROW IN GLASGOW.—The Glasgow Corporation, which has introduced a municipal telephone system for the benefit of the citizens of the commercial capital of Scotland, has met with opposition from an unexpected quarter in extending its operations. At a meeting of the Town Council a lively discussion arose over a letter received from the directors of the Glasgow Royal Exchange refusing the corporation accommodation in the exchange buildings for the municipal telephones. Bailie Robertson said that if the exchange directors put the onus of the refusal on the National Telephone Company, it was for the latter to consider whether were consulting their own interests in refusing facilities to the corporation, from whom they had received so many privileges. As a way out of the difficulty, Lord Provost Chisholm pointed out that although the basement and top flats of the exchange were leased to the National Telephone Company, there was nothing to hinder the municipal telephones being introduced by a window to the intermediate floor. Further consideration of the matter was postponed. It would appear that the Exchange thinks the bother of one telephone service quite enough.

# General News.

## THE TELEPHONE.

NOGALES, ARIZ.—During the year the Sunset Telephone Company, of Arizona, has completed a line from Jerome to Nogales, making a long-distance connection of 400 miles. A competing company is building from Prescott to Congress, and will connect with opposition companies building from Bisbee and Safford. Another private corporation is to build a telephone line up the Colorado from Yuma.

SANTA ROSA, CALIF.—The Pacific States Telephone & Telegraph Company is materially increasing its telephone equipment in Santa Rosa.

SAN FRANCISCO, CALIF.—Salinas, Calif., and Monterey will soon be connected by a new telephone line of heavy copper wire, which will become a part of the Pacific States Telephone & Telegraph Company's long distance system.

LOS ANGELES, CALIF.—A $25,000 bond has been filed in Los Angeles, Calif., by M. Adrian King for the possession of a telephone franchise under which he will be required to expend $25,000 within four months. He is also required to carry on the work, without delay until the entire system is completed.

MACON, GA.—Emil Dorn, of Chicago, has applied to the city of Macon for franchise to establish a telephone system.

CARROLLTON, GA.—The Gainsboro Telephone Company has begun the erection of a line to Roopville. Arrangements have also been completed for a local exchange at Dallas, Ga., in connection with the long distance service. During the coming summer it is said a local exchange will be put in at Tallapoosa in Haraloon County.

PLEASANT PLAINS, ILL.—Boyntown Telephone Company has increased its capital stock from $2,500 to $10,000.

CHICAGO, ILL.—The Chicago Telephone Adjustment Company, capital stock $2,500, has been incorporated by Wilton B. Judd, M. W. Shanahan and J. F. Esperson.

HARDIN, ILL.—A farmers' telephone company has been organized in Calhoun County, with headquarters at Belleview, Ill. H. C. Long is the president of the new company.

ATWOOD, ILL.—The Atwood Mutual Telephone Company, with a capital of $3,000, has been incorporated. The incorporators are C. B. Moore, H. H. Wildman and William D. Harshbarger.

ALTON, ILL.—Rural telephone lines are being built throughout the county around Alton, and extensions are being made in all the small towns. At Grafton a new telephone exchange is being established by the Central Union, and many other small towns in the vicinity of Alton are being connected up. The farmers say this telephone is invaluable to them.

ELGIN, ILL.—The Stromberg-Carlson Company, of Chicago, has furnished the apparatus for the new exchange at Elgin. It includes a switchboard of the lamp line indicator type, full multiple, with a present capacity of 800 subscribers' lines and an ultimate of 2400. A corresponding number of Stromberg-Carlson telephones is also being supplied. The exchange will soon be in operation.

LA PORTE, IND.—The La Porte Telephone Company has been reorganized, S. I. Kesselaer, the president and manager, selling his stock to W. W. Hanns, L. M. Kugler and J. V. Doreland.

MUNCIE, IND.—Municipal ownership sentiment is rife here and at Aurora. The people insist on the proposition being submitted at the spring elections. In the meantime municipal ownership leagues are being formed. Electric light and water are the utilities involved.

INDIANAPOLIS, IND.—Hon. S. P. Sheerin, president of the New Telephone Company, has just returned from a pleasure trip to Mexico. He thinks Mexico has great possibilities for the telephone. The great mineral wealth of the country and the agricultural opportunities and improvements through the aid of irrigation, and the large landed estates or holders is destined to make telephone communication a necessity.

EVANSVILLE, IND.—The city authorities are in a state of bewilderment over the telephone situation. The franchise of the Cumberland company, granted fifteen years ago, will expire in a few months, and now there is a clamor for a franchise from half a dozen companies. The Cumberland company will also be a bidder for a new franchise. The independent companies are knocking at the door and will make a strong effort to unhorse the local company. The matter of a franchise has been taken up by the people, and they are pretty equally divided on the question of having competition in the telephone business. In the meantime the Council is struggling with the several factions and the situation is not only interesting, but strenuous.

INDIANAPOLIS, IND.—Telephone enterprise took on a new spurt in this State during the past week, evidenced by the following new companies that filed articles of incorporation with the Secretary of State: The Lawrence Telephone Company, of Lawrence; capital, $3,500; directors, W. W. Hinman, R. S. Records and others. The Six Miles Telephone Company, of Charlottsville; capital, $2,100. The Kennedy & Nowland Telephone Company, of Markleville; capital, $3,000; President, Wm. Kennedy, of Markleville. The Falmouth Telephone Company; capital, $5,000. The Hope Telephone Company, of Hope; capital, $12,000, and the National Automatic Telephone & Telegraph Transmitter Company, of Valparaiso; capital, $10,000.

INDIANAPOLIS, IND.—During the recent annual convention of township assessors in this city much discussion was had on the subject of taxation of the telephone property in the State. Auditor Hart read a paper on "The State's Sources of Revenue." Mr. Hart advocated taxing telephone franchises and also exacting a certain per cent of the gross receipts of those in operation. Union B. Hunt, Secretary of State, read a paper on "The Assessment of Telephone Property." He said the law provided that the instruments and office property of telephone companies are to be assessed by the local assessors, all other property of the companies by the State Board of Tax Commissioners, which board is to find the true cash value of such property by adding to the mortgaged value of the aggregate shares of stock, or to the value of the capital, the aggregate amount of said mortgage or mortgages, and the result is deemed and treated as the true cash value of the property of said corporation. The telephone and telegraph property of the State is assessed at $4,000,000.

IOWA CITY, IA.—The Johnson County Telephone Company has increased its capital stock from $15,000 to $30,000.

NEW MARKET, IA.—The East River Farmers' Mutual Telephone Company has been organized here. J. B. Foster is president.

MINBURN, IA.—A mutual telephone company has been organized at this place, and a special election has been called for March 31 to vote on the franchise.

VILLISCA, IA.—At the city election on March 17 a proposition to grant a franchise to the Villisca Farmers' Mutual Telephone Exchange will be submitted to a vote of the people.

DES MOINES, IA.—The Senate has passed a bill granting to any community the right to vote a 5 per cent tax in aid of independent telephone companies. It is stated that there is some doubt of its passing the House.

IOWA CITY, IA.—The Iowa City & West Branch Telephone Company has recently been organized. The officers are: J. T. Struble, president; George Hunter, vice-president; James Murphy, secretary, and James Douglas, treasurer.

OAKLEY, KAN.—The Oakley Telephone Company, capital stock $1,000, has been incorporated.

HOPKINSVILLE, KY.—The annual meeting of the stockholders of the Cumberland Telephone Company was held here. An increase of 19,000 subscribers was made during the year, making the total number 76,000.

NEW ORLEANS, LA.—The Merrill & Leakville Telephone Company, of Merrill, has been incorporated by E. Rose, W. R. Rhinehart, Sam Pool, James Faulk, J. H. Tune and M. L. Batson; capital stock, $1,000.

EASTPORT, ME.—The Lakeside Telegraph & Telephone Company has recently been granted a franchise by the City of Eastport.

GRAND RAPIDS, MICH.—A new directory of the Citizens' Telephone Company of this city shows that there are 4121 telephones in service, a gain of 562 since the directory of last May was issued. The company now has 776 toll line points in the State and a total of 28,276 telephones, as against 27,607 six months ago. Within the past six months the company's net gains in the number of telephones in use at various points throughout the State have been as follows: 333 in Lansing, 160 in Traverse City, 76 in Lowell, 79 in Caledonia, 55 in Vermontville. In this city an impetus has been given to the business of the Citizens' company by the advances in rates announced for the first of the year by the Michigan Telephone Company, and since Dec. 1 last more than 500 orders for telephones have been booked.

CLEVELAND, MISS.—The Bolivar Telephone Company, of Cleveland, Miss., capital stock $10,000, has been incorporated by S. L. H. Graynes, J. G. Collier, W. P. Parks and others.

FAIRFAX, MO.—The Fairfax Telephone Exchange Company, with a capital of $5,000, has been incorporated by John Punsham, William A. Groesbeck, Nellie Morgan and others.

YORK, NEB.—The City Council has granted a twenty-year franchise to the Plattsmouth Telephone Company.

OMAHA, NEB.—The independent telephone companies of Nebraska are endeavoring to get in close touch with each other with the avowed object of fighting the Bell telephone. It is their intention to build connecting lines, and if possible, form a community of interest plan, which will embrace all independent companies in the State.

BOONTON, N. J.—The Boonton Telephone Company, Boonton, N. J., has been incorporated; capital, $5,000. Incorporators: Geo. W. Frutchey, Edwin A. Fisher, Frederick Gordon, Thos. J. Hillery, Edmund B. Morton, Robert Green, Frank H. Coe and Frank Wendt.

PATERSON, N. J.—It appears that the telephone exchange destroyed during the recent great fire at Paterson was the independent, and not the Bell, as first stated. The latter has been giving great service since the fire, the telephone naturally proving invaluable under such conditions.

ALBANY, N. Y.—The Midland-New York Telephone Company, New York, capital $25,000, has been incorporated. Directors: F. F. Culver, A. S. White and F. H. Lord, New York.

ALBANY, N. Y.—The Belmont Citizens' Telephone Company, Allegany County, capital $1,500, has been incorporated. Directors: W. P. Clark, J. P. Crosby and J. E. Middaugh, Belmont.

NEW YORK, N. Y.—In compliment to Prince Henry of Prussia, the New York Telephone Company has placed a number of telephones on the Emperor's yacht "Hohenzollern." The telephones are connected by direct lines with the city exchange system, and both local and long distance service is being furnished. The lines are kept in almost constant use.

NEW YORK, N. Y.—J. T. Sproull and John P. O'Brien have been elected directors of the Knickerbocker Telephone & Telegraph Company, succeeding William H. Eckert and W. Stanley Eckert. It is said that Henry S. Kearny, president of the Telephone, Telegraph & Cable Company of America, will succeed Colonel Eckert as president of the Knickerbocker Company.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Company has made a reduction of about 50 per cent. in rates for telephones in homes in Syracuse. The special metallic line, with a service within a one-mile radius of the central office of the company, which formerly cost $66, is now $48. The two-party metallic selective signal telephone, which formerly cost $51, is now $36. In addition to this reduction, the radius of service has been extended to two miles, cutting off the $5 a quarter mile additional charge, and making the special long distance metallic instrument within a radius of two miles of the central office in any direction now cost $48 instead of $66 and $20, or a total of $86. The company has also reduced the measured service business rate to $43, for the special metallic instrument with 800 calls, from $50, with but 500 calls; and the two-party business rate to $33, with 800 calls, from $40, with 500 calls. The rate for additional calls has been reduced from 5 to 2 cents.

BROOKLYN, N. Y.—An investigation is being made by officials in Brooklyn Borough into the affairs of the Orr Telephone Company, recently incorporated with a capital stock of $3,000,000. While the company's headquarters are in Buffalo, it has found investors all over the country, many of them in New York, Brooklyn and nearby towns. Its promoters have been operating so quietly that the general public has known little or nothing of their remarkable success in disposing of stock. Circulars have lately been sent out by the company with a view to raising $200,000 more. The circulars claim that the company has acquired or is about to acquire a franchise to operate a telephone service in Brooklyn. Deputy City Clerk James V. Sculley, in charge of the Brooklyn office, received one of these circulars inclosed in a letter from an anxious investor. So far as appears, the company has no franchise, but owns the Orr telephone receiver invented by a Buffalo person. The "receiving" part of the system seems to work all right.

GASTONIA, N. C.—The Gastonia Telephone Company is building a double metallic line to Lincolnton.

WILMINGTON, N. C.—It is reported that the Bell Company will extend its line to Carolina Beach next summer.

GREENSBORO, N. C.—The Southern Bell Telephone Company is seeking a franchise to put in a local exchange.

YADKINVILLE, N. C.—A telephone line from Yadkinville to Hamptonville, thence to Buck Shoals, is said to be assured.

ASHEVILLE, N. C.—A request from Dr. Emil Dorn, of Chicago, for a telephone franchise has been refused. A system is already in operation.

BERLIN, OHIO.—The Berlin Telephone Company, capital stock $1,350 has been incorporated.

TONTOGANY, OHIO.—The Mutual Telephone Company has been organized and will build a local exchange.

BATAVIA, OHIO.—The Bell Telephone Company will ask the Council of Bethel for a franchise in that village.

FAYETTE, OHIO.—The Fayette Telephone Company has increased its capital stock from $10,000 to $25,000, to provide for improvements.

CONNEAUT, OHIO.—The Conneaut Telephone Company is making extensive improvements to its exchange. A new board of increased capacity is being installed.

CHAGRIN FALLS, OHIO.—Chagrin Falls was snowbound recently, and the town was in darkness because the Chagrin Falls Electric Company could not secure fuel.

CINCINNATI, OHIO.—George W. Rapp & Sons, of this city, are preparing plans for an exchange building to be erected at Norwood by the City & Suburban Telegraph Association.

COLUMBUS, OHIO.—The Columbus Messenger & Signal Company has asked for a twenty-five-year franchise for the use of the streets for the purpose of constructing and maintaining a messenger and signal service.

WARREN, OHIO.—F. H. Stowe, for a number of years manager of the Ashtabula exchange of the Central Union Telephone Company, has accepted the position of general manager of the Columbia Telephone Company at Portland, Oregon.

BATAVIA, OHIO.—The Citizens Telephone Company, which was recently organized here, is using Stromberg-Carlson apparatus. It has 500 subscribers and contemplates extending its lines to Bethel, Ohio, and later on to Mount Washington.

POMEROY, OHIO.—The Coolville Home Telephone Company is building a line from Rock Springs to this place. Lines are also being built to Bottom and Reedville, and communication will thereby be opened with the entire eastern portion of the county.

DAYTON, OHIO.—The Acme Telephone Company, of Center Post Office, has been incorporated, with $8,000 capital stock, by G. T. Brown, N. W. Rinehart, G. E. Lees, E. M. Brumbaugh, and Enos Shellabarger. The company will build a farmers' community system.

EAST ROCHESTER, OHIO.—The Eastern Ohio Telephone Company, operating in East Rochester and vicinity, is arranging to make traffic arrangements with both the Stark County Telephone Company and the Columbiana County Telephone Company. Long distance service will be secured over both lines,

CINCINNATI, OHIO.—Preparations have begun for the removal of the office of the Long Distance Telephone Company to the office building of the City & Suburban Telegraph Association. The Long Distance people will occupy the entire fourth floor and will utilize a large room on the ground floor for offices and booths.

McCONNELLSVILLE, OHIO.—The McConnellsville Home Telephone Company is building a line from Rencock to Bristol to connect with a line to be built from McConnellsville to Reinsersville. This will give direct connection from McConnellsville to Caldwell, as the Noble County Telephone Company has a line to Renrock.

ASHLAND, OHIO.—The Central Union Telephone Company has brought action in the Common Pleas Court to compel the Council of Ashland to grant the company a franchise for a local exchange. A number of the Councilmen are stockholders in the Star Telephone Company which operates in the town, and they refuse to act.

WARREN, OHIO.—The Warren City Council has passed an ordinance requiring the Warren & Niles Telephone Company, the Central Union Telephone Company, and the Western Union and Postal Telegraph companies to place their lines underground in the business portion of the city. The work must be completed by July 1, 1902.

EAST LIVERPOOL, OHIO.—Angered at the practice of the Bell Telephone Company of erecting poles and making changes without permission of the Council, the East Liverpool Council has adopted a resolution creating the office of city telephone inspector, and the telephone company has been notified that it must stop all work until it is willing to pay the salary of the inspector.

NORTH LIMA, OHIO.—The recently organized Beaver Telephone Company has failed to make long distance traffic arrangements with the Columbiana County Telephone Company, and it may decide to erect its main exchange at Columbiana instead of North Lima as originally proposed. It will probably build a number of toll lines and enter into competition with the Columbiana County Company.

SHREVE, OHIO.—The Shreve Council has declined to grant a franchise to the Ripley Township Telephone Company. The Millersburg, Wooster & Orrville Telephone Company has an exchange in Shreve, but the farmers of the surrounding country are dissatisfied with the rates and organized their own company. They propose to go into the courts for the privilege of operating an exchange in the town.

KENTON, OHIO.—The Kenton Home Telephone Company held its annual meeting a few days ago. Officers were chosen as follows: J. L. Moore, president; J. B. Seymour, vice-president; A. G. Wessling, secretary-treasurer. It was decided to put in new sections of switchboard to take care of the rapidly growing business and to entirely remodel the system. The cable capacity in the city will be increased and new lines will be built into the surrounding country.

HAMILTON, OHIO.—The City & Suburban Telegraph Association of Cincinnati has brought suit against the Hamilton Home Telephone Company and the Hamilton, Hughes & Monroe Telephone Company. It is claimed that the first-mentioned company is not the successor of the second mentioned company, and that it has no rights in the streets of Hamilton, and it claims that both companies are installing wires which will damage the system of the plaintiff.

CLYDE, OHIO.—The Clyde Telephone Company held its annual meeting a few days ago. Officers were elected as follows: H. V. Becker, president; Dermont E. Fuller, secretary-treasurer. During the year 1901 the company changed from a common return to the full metallic system; built about twenty miles of pole line and put up considerable cable in the village. The company has 310 subscribers and toll stations at Erlin, Vickery, Whitmore and Tork Station. Many farmers are asking for connections and the company will make numerous extensions to its farmers' system this year.

HAMILTON, OHIO.—The Hamilton Telephone Company has been incorporated by S. D. Fitton, Sr., F. W. Whitaker, O. M. Bake, F. M. Hughes, J. C. Slayback, W. W. Morrison and C. E. Greismer. The company succeeds the Hamilton, Hughes & Monroe Telephone Company, and it will take immediate steps to build an independent exchange in Hamilton, the only large city in Ohio, with the exception of Cincinnati, which has no independent exchange. The construction work will be in charge of D. E. Newman and W. W. Morrison, of Bryan, Ohio, who have built a large number of exchanges. Work of securing subscribers has been started, and within a week 100 were secured. It is guaranteed that the company will have 600 subscribers before patrons are asked to pay for service. The rates will be $18 per year for residences and $30 for business houses.

TOLEDO, OHIO.—The Toledo Home Telephone Company has pushed construction work throughout the winter and has practically completed the overhead and underground construction; something over 400,000 feet of cable having been laid. About April 1 the offices and new buildings will be completed. The switchboard will have a capacity of 17,000 connections, 5000 for East Toledo and the balance for the city proper. Between 5000 and 6000 subscribers have been secured, all of whom will have full metallic circuits and unlimited service. The company has copper wires running from Maumee into its office connecting Bowling Green, Fostoria, Findlay and Lima, and lines connect Ft. Wayne, Holland, Wauseon, Bryan, Delta, Swanton, Archbold, Fayette, Napoleon, Defiance, Sandusky, Fremont and other towns to the east and Michigan points to the north.

SHAWNEE, OKLA.—The Long Distance Telephone Company, capital $100,000, has been incorporated by James F. Nobles, of Shawnee; Eugene D. Simms, of Roff, I. T., and James L. Lombard, of Kansas City, as directors.

PENDLETON, ORE.—A co-operative telephone company has been organized by the farmers around Pendleton, with the intention of installing quite a large system.

PORTLAND, ORE.—S. L. Shuffleton has been granted a franchise for a lighting plant for a small section of Portland. The wires will all be put underground.

PORTLAND, ORE.—The Pacific States Telephone & Telegraph Company, at its recent stockholders' meeting held in Portland, authorized the expenditure of $2,100,000 for improvements of the system and extensions of lines.

MORGANTOWN, PA.—A local telephone company promoted by farmers and business men has been organized here.

LEAD, S. D.—The Black Hills Telephone Company has asked for a franchise to conduct its business in Lead and has agreed to put in a fire alarm system without cost to the city.

ALEXANDRIA, S. D.—Taylor Township Telephone Company, Alexandria, capital stock $3,700, has been incorporated by Magnus Johnson, John Schroeder, C. E. Twombley, W. M. Newell, Dean Beakman, Wm. Morrow and Edward Wenenda.

MILLTOWN, S. D.—The Milltown Telephone Company, capital $25,000, has been incorporated by J. B. Welch, G. E. Brown and W. J. Wooper.

LENNOX, S. D.—The Lennox Telephone Company, capital $5,000, has been incorporated by E. S. Heinrich, John Waldron, W. H. Gerick and W. J. Heinrich.

BON AIR, TENN.—The Gainsboro Telephone Company will, it is said, build a line to Ravens Croft, a coal mining point.

CENTERVILLE, TENN.—An effort has been started by I. B. Parker, former local manager of an exchange at Centerville to build a new and independent system.

NASHVILLE, TENN.—Two telephone companies are now seeking franchises in this city—the Tennessee Telephone & Telegraph Company and a company represented by Harvey Myers, J. S. Alsthrop and others.

TRINITY, TEX.—The W. A. Bell Telephone Company, capital stock $10,000, has been incorporated.

WICHITA FALLS, TEX.—The Texas Telephone Company has increased its capital stock from $12,000 to $24,000.

BALLINGER, TEX.—The Central Texas Telephone Company, capital $50,000, has been incorporated by L. C. Alexander, A. Schane, J. B. Wilmeth and R. A. Hall and W. A. Norman.

SALT LAKE CITY, UTAH.—According to the reports for 1901, on file in the office of the State Auditor of Idaho, there was 1154.15 miles of telegraph lines and 2,907.25 miles of telephone line in the State.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will at once commence to build a line to the great Thunder Mountain mining district. This line will run from Boise, via Idaho City, and will be a little over 150 miles in length. All towns on the new line will be connected.

MARTINSVILLE, VA.—A conditional order has been entered by the Town Council granting a franchise to the Martinsville Telephone Company. A committee was appointed to draft a suitable contract. D. L. Bowles is president of the company. The Town Council has rejected a proposition for municipal ownership of the local telephone system.

BLOOMER, WIS.—The Bloomer Telephone Company has been offered $6,000 for its system and exchange by Chicago parties.

MILWAUKEE, WIS.—The American District Telegraph Company will make general improvements on its system in this city.

WAUSAU, WIS.—Crossed electric wires damaged the switchboard of the telephone exchange to the extent of totally burning three sections of the large board.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has filed its annual report with the State Treasurer. The report shows that the value of its real estate exclusive of its lines is $261,686.83. The company operates 49,366½ miles of wire and owns 22,451 instruments. During the year ending Dec. 31, 1901, gross earnings amounted to $805,456.77, on which it pays a tax of 3 per cent, or $24,163.70.

MILWAUKEE, WIS.—Mr. Albert E. Smith, of this city, is back of a new telephone company, which has made application for a franchise. The ordinance requires the company to install 2000 telephones inside of five years; the police and fire departments are to have telephones for $25 a year and the privilege of stringing their wires on the poles of the company. The company also is to observe the two-mile underground conduit limit, the city, after twenty-five years, having the right to demand that the underground wire system be extended to all lines within the city limits.

## ELECTRIC LIGHT AND POWER.

VALDES, ALASKA.—An electric lighting plant is being installed in the town of Valdes by Messrs. Love and Whitney, who have applied for a franchise for the use of the streets for a pole line.

TEMPE, ARIZ., has voted $30,000 for a new water service, and will probably add an electric lighting system.

SAN FRANCISCO, CALIF.—The Edison Electric Company recently received permission to construct an electric power transmission line from Colton to San Bernardino, Calif.

SAN FRANCISCO, CALIF.—The California Mine, Nevada County, Calif., is to be equipped with heavy machinery and operated by electric power, under the supervision of Manager George Levinsky.

SAN FRANCISCO, CALIF.—An electric power plant will be installed by F. P. Hurst, who has filed on a water right, and will transmit power to operate flour mills in Canby and Aurora, Oregon.

SAN FRANCISCO, CALIF.—The California Powder Works Company is constructing a new pulp factory at the Hercules plant. Electric power will be used to drive the machinery of the new installation.

SAN JOSE, CALIF.—The Electric Improvement Company, San Jose, recently petitioned the Board of Supervisors for a franchise for the establishment of an electric transmission line along the road to Santa Clara.

SAN FRANCISCO, CALIF.—The Winscott mine, owned by A. C. Mason, in the State of Washington, will be equipped with new machinery at a cost of $75,000, and operated by electric power. A large reservoir will be a feature of the hydraulic work.

SAN FRANCISCO, CALIF.—The Blue Lakes Manufacturing Company, which was recently incorporated by E. H. Jones, Isaac Culver and others, will install an electric light plant at Blue Lakes, Humboldt County, Calif., where they are erecting a shingle mill.

SAN FRANCISCO, CALIF.—The Department of the Interior, Office of Indian Affairs, has advertised for proposals, until March 27 for the construction of nine buildings and the necessary sewer, steam heating, water, and electric lighting systems therefor. The buildings will be erected in Arizona.

SAN FRANCISCO, CALIF.—The jute mills in San Quentin penitentiary, Calif., are now operated by electricity from the Bay Counties Power Company's transmission lines. It is claimed that, by the use of electric motors, there is a saving of 150 horse-power over steam and an annual saving in fuel, etc., of $7,000.

SAN FRANCISCO, CALIF.—Fifteen thousand acres of land were recently conveyed to Alex. F. Morrison, of San Francisco, the consideration being $375,000. The transfers were made for a syndicate who desired to control the land bordering on the headwaters of Coyote Creek on account of the valuable water rights involved.

SAN FRANCISCO, CALIF.—The South Yuba Water Company is reported to be making surveys for a transmission line to supply electricity in Grass Valley and Nevada City, Calif., in competition with the Bay Counties Power Company. It is proposed to locate the water-power electric generating station in Alta, twelve miles from Grass Valley.

SAN FRANCISCO, CALIF.—The Mariposa Electric & Power Company is about to begin work on its hydraulic electric power plant, which will be installed on the Merced River nine miles above Benton Mills, Calif. The engineer is N. C. Ray, of Coulterville. It will be necessary to construct a steel trestlework 200 feet in height and 900 feet long.

SAN FRANCISCO, CALIF.—Successful results have been obtained with small electric irrigating plants by farmers in Santa Clara County near Berryessa, Calif. The Standard Electric Company will supply current from its transmission lines for the operation of a 5-hp induction motor to run an irrigating pump on the ranch of F. H. Bean, and the service may be extended.

SAN FRANCISCO, CALIF.—The Keswick Electric Power Company, which is operating a Westinghouse transmission plant, located in Shingletown, Shasta County, Calif., expects to float bonds and install a duplicate of its plant on Mill Creek. There is ample water power for both electric stations. The Keswick Company intends to extend its transmission line to Red Bluff.

RED BLUFF, CALIF.—The Tehama Electric Light Company, Red Bluff, is rebuilding its steam power electric generating station, which was recently almost destroyed by fire. There is a transmission line about twelve miles in length which supplies the towns of Vina and Corning with electricity. Fred. Christie, the night engineer, was accidentally killed on the night of the fire.

SAN FRANCISCO, CALIF.—It is reported that San Francisco capitalists recently purchased the canal and water rights of Main River Water Company on the Stanislaus River in California. A large electric power transmission plant is projected by the new owners. The proposed site is on the main stream, near the beginning of the old miners' ditch, terminating near Hale's Mills, on the South Fork of the Stanislaus.

SAN FRANCISCO, CALIF.—A hydro-electric transmission plant will be installed on the Noaksack River in the State of Washington by P. B. Cornwall, one of the owners of the Bellingham Bay & B. C. Railway. The capacity of the plant will be 5000 horse-power, and the distance of transmission to Whatcom and the Bellingham Bay towns, about thirty miles. A short electric railway will be constructed through the mountains as a branch of the Bellingham Bay & B. C. Railway.

CALDWELL, IDAHO.—An 800-light electric plant will be installed in Caldwell by W. R. Sebree, who was recently granted a lighting franchise.

BOISE, IDAHO.—The Electric Power Company, of Boise, has been granted a franchise to run an electric light and power line through this city.

LEWISTON, IDAHO.—E. H. Libby and associates have come into the possession of the Lewiston Electric Light Company, of Lewiston. The price paid is reported at $500,000. The new stockholders elected the following board of directors: Henry Adams, W. H. Boweker and Elbert Wheeler, of Boston; W. F. Kettenback, W. W. Lepeer, E. H. Libby and S. H. Reed, of Lewiston.

ALTON, ILL.—A new electric lighting company, backed by prominent Alton business men, is being organized for the purpose of furnishing lights in the business district of the city. The new company will be for the mutual benefit of the stockholders, and will furnish light at a figure as near actual cost as can be done. Mr. Edmond Beall will organize the company. The patrons will be asked to sign a five years' contract to take light. It is expected to have the plant in operation within two months. An arrangement is being made with the Kinloch Telephone Company for the use of its poles. Incandescent lighting alone will be done; later arc lights may be furnished. The new company will be incorporated with $25,000 capital. An option for ground for the plant has already been procured.

KOKOMO, IND.—George J. Marrott, of Indianapolis, has purchased the electric light system of this city. T. C. McReynolds will continue as manager.

HOMER, LA.—A movement is now on foot to establish an electric plant and system of waterworks here at an early date.

MONROE CITY, MO.—Since the destruction of the electric light plant by fire some time ago the city has been in darkness, and the business men are protesting. The City Council has called a mass meeting to decide the advisability of calling an election to vote on the proposition of issuing bonds and putting in a first class plant owned by the city.

HELENA, MONT.—The Missouri River Power Company has completed a line for transmitting power from its dam and plant at the Missouri River to Butte. The length of this line is sixty-five miles, and it crosses the main range of the Rocky Mountains at an altitude of 7200 feet, and a spur of the main range at almost an equal height. At present the line conveys 12,000 horse-power, but it is intended to double the power by the construction of another dam.

SHELBY, N. C.—Since the closing of the municipal electric light plant, A. C. Miller and Chas. Eskridge have offered to furnish lights at $65 each. The aldermen have proposed to give $60 per light.

MADISONVILLE, OHIO.—The village has sold $25,000 5 per cent. 20-30-year optional water and electric light bonds.

CANTON, OHIO.—A proposition to issue $20,000 worth of electric light bonds for the purpose of improving the plant has carried.

ZANESVILLE, OHIO.—The City Council has granted a franchise to the Citizens Electric Light Company, on condition that a number of lights be supplied to the city free of charge and a plant be constructed within eighteen months.

SANDUSKY, OHIO.—At the recent annual meeting of stockholders of the Sandusky Gas & Electric Company officers were elected as follows: Barney Mahler, president; C. B. Wilcox, vice-president; A. L. Moss, treasurer, and F. W. Coen, secretary.

SHREVE, OHIO.—The Shreve Citizens Electric Light, Power & Heating Company held its first annual meeting a few days ago. Reports showed that the earnings during the month of January were $131 and the expenses $128. The dividend was paid in cigars.

GREENVILLE, OHIO.—The Village Council of Greenville has granted a franchise to the Greenville Electric Light & Power Company. The company will furnish the village with 100 arc lamps at the rate of $87 on an all-night schedule except on moonlight nights. Commercial lighting is to be furnished at 15 cents per kilowatt.

PENDLETON, ORE.—An electric lighting plant is projected, in connection with a new paper mill in Pendleton by F. Wallers.

RICHMOND, VA.—Lane & Company will build a power-house at Warren on James River to supply power to a number of manufacturing plants.

EVERETT, WASH.—Electric lighting franchises have been asked for in Everett by the Snoqualmie Falls Power Company and J. A. Faulkner. The ordinance granting the latter franchise will call for work to commence within six months and to be completed two years later.

RACINE, WIS.—Articles of incorporation have been filed by the Wisconsin Heat, Power & Light Company. Martin Clancy, C. M. Dietrich, Jeus Jensen and Peter B. Nelson are the incorporators. The capital stock is $25,000. It is said that the company is ready to spend $175,000 in building the plant. A franchise will be asked of the Council. The company will be a competitor of the Milwaukee Electric Railway & Lighting Company.

## THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has secured a franchise for an extension of its lines, also to extend their tracks in Ensley, Ala.

FLORENCE, ALA.—The question of extending a franchise for an electric light and railway system is being discussed. Promoters who obtained a franchise eight months ago now seek a renewal of same.

SAN BERNARDINO, CALIF.—The San Bernardino Traction Company has been granted a franchise for an electric railway line on Colton Avenue, in San Bernardino.

SAN FRANCISCO, CALIF.—Messrs. S. N. Griffith and W. H. McKenzies have been granted a franchise for a suburban car line for transporting passengers and freight to Fresno, Calif.

SAN FRANCISCO, CALIF.—The San Francisco & San Mateo Electric Railway Company has been granted a franchise for the construction of its line from Colma to the city limits of San Mateo, Calif.

SAN FRANCISCO, CALIF.—The Pacific Heights Electric Railway Company has been incorporated in Honolulu, H. I., to build an electric railway to Nunanu, Pali, by Charles S. Desky, J. B. Atherton, George P. Castle, F. M. Hatch and Joseph B. Pratt.

SAN FRANCISCO, CALIF.—The City Council of Helena, Mont., has been asked to grant electric light and street railway franchises to the Citizens' Electric Company, which was recently incorporated, with a capital stock of $100,000 by C. Yeagen, Peter Yeagen, J. F. Kurtz and F. J. Walters.

SAN FRANCISCO, CALIF.—A claim for a water right for electric power purposes has been filed by John Burson, who has also applied for a franchise to build an electric railway through Ventura County to Bakersfield, Calif. The stream from which the water is to be taken is the Big Sespe.

SAN FRANCISCO, CALIF.—The San Jose & Santa Clara Railway Company is changing over the Alum Rock Park branch to an electric line, and is installing additional generating machinery for its operation. The electric power equipment will consist of a three-cylinder 11x12 Westinghouse gasoline engine, to be operated by crude oil, direct connected to a Westinghouse generator. The distance from San Jose to Alum Rock is eight miles. The engine was ordered through C. C. Moore & Company, San Francisco.

LOS ANGELES, CALIF.—The contest for the franchise of Los Angeles Railway is creating much interest in San Francisco. The whole question is outlined by Attorney T. A. Gibson is as follows: "It is true that W. A. Clark has agreed to take an interest with the traction company in the construction of street railway systems in this city. When representations were made to Senator Clark that the Huntington-Hellman syndicate was planning to get a blanket-franchise for the city, and so force all rival lines to sell out, Senator Clark and some of his friends determined to acquire Los Angeles franchises and block the plans of the monopoly."

SAVANNAH, GA.—The Savannah Electric Company has recorded at Atlanta an issue of $3,500,000 5 per cent gold bonds to run for fifty years, and payable at Boston, Mass. The company is now constructing fifty-three miles of electric railway.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has increased its capital stock to $500,000.

KOKOMO, IND.—The Union Traction Company has located its power-house for its Kokomo & Indianapolis branch line in this city.

RICHMOND, IND.—The Richmond Interurban Railway Company has let the contract for its Centreville and Cambridge City extension.

LOGANSPORT, IND.—The Logansport & Kokomo Railway Company has been incorporated, with $500,000 capital stock. The incorporators are Messrs. Lau and Stoneman, of Detroit.

LEBANON, IND.—A thirty-year street railway franchise has been granted to the Indianapolis & Lebanon Traction Company. The consideration is a fee of $8,000, and the location of the power-house in this city.

VINCENNES, IND.—The Ft. Wayne Construction Company is suing to foreclose a lien for $23,000 on the local electric light plant. The Sechner company of St. Louis, and the Northern and Royal Trust companies, of Chicago, are made co-defendants.

KOKOMO, IND.—George J. Marott, of Indianapolis, has purchased the Kokomo street railway plant, and effected a consolidation with a view to building a line to connect this city with Logansport, where Mr. Marott owns the local street railway system.

TRENTON, N. J.—The United Railways Investment Company of San Francisco has been incorporated in New Jersey "to deal in securities," according to the application. The capital is $2,500, paid up.

BROOKLYN, N. Y.—The repair shops and car yards of the Brooklyn Rapid Transit Company were recently visited by a fire which destroyed ten elevated cars, with motors, etc., and did damage to the amount of about $200,000.

OSSINING, N. Y.—The Westchester Traction Company has taken full possession of the electric street-car line, at Ossining, and intends to put in a new electric plant at the power station, all new rolling stock, and to extend the line to Pleasantville and White Plains as soon as the weather will permit. The company has also purchased the plant of the Ossining Heat, Light & Power Company, and will put in an entirely new alternating-current plant, and be able to furnish power for motors all over town. The capital of the new organization is $300,000, and the directors are Thos. F. Barrett, New York; J. V. Lockhart, Ossining and Harry M. Shaw, East Orange.

BROOKLYN, N. Y.—J. Edward Swanstrom, president of the Borough of Brooklyn, sent to the Board of Rapid Transit Commissioners last week a long communication, requesting that the proposed rapid-transit extension to Brooklyn be made a four-track system instead of a two track system, and that, if the city could not afford so great a change, four tracks be laid at least as far as the Battery loop. He declared that already the travel to Brooklyn was so great that a two-track system would be unable to cope with it, and that, in view of the immense development which he anticipates for that borough, a two-track system would be worse than useless in the future. He called attention to the switching system, by which the Brooklyn trains would leave the Battery branch at Pine Street, and declared that a switching system would be a constant source of danger.

GREENVILLE, OHIO.—The Greenville Council has granted a 25-year franchise to the Dayton & Northern Traction Company.

MANSFIELD, OHIO.—The Norwalk, Greenwich & Mansfield Railway has applied for franchises in Mansfield and Richland counties.

BELLEFONTAINE, OHIO.—Right of way has been secured for an extension of the Dayton, Springfield & Urbana Railway from Urbana to Bellefontaine.

TROY, OHIO.—The Dayton, Covington & Piqua Railway Company, which is building a line to Piqua, will probably build a spur line from Pleasant Hill to Troy.

CONNEAUT, OHIO.—The Conneaut Council has granted a franchise through town to the Conneaut & Eastern Railway, a road which will complete a through electric railway from Erie to Cleveland.

TOLEDO, OHIO.—The Toledo & Southern Electric Railway Company has sold out to the Toledo, Columbus, Springfield & Cincinnati Railway Company. It is said the consideration was $100,000.

GREENVILLE, OHIO.—The Greenville, Versailles & Northern Traction Company has been incorporated, with $1,000 capital stock, by Jacob R. Strocker, Wm. G. Mergler, W. A. Brown, H. J. Yount and William Lutz.

MARION, OHIO.—Hon. David Joy, president of the Findlay & Marion Electric Railway, claims that all right of way for the line has been secured. The town of Carey has donated four acres of land and $5,000 for the location of the power plant in that place.

WEST UNION, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway Company may extend its road from Georgetown to this place. The road is to be changed to standard gauge and passenger cars are to be operated by electricity and freight cars by steam.

CLEVELAND, OHIO.—Mr. R. L. Palmer, formerly general manager of the Cleveland & Chagrin Falls Railway, is interested with other Cleveland people in the construction of a line in Florida to extend from Tampa to Sulphur Springs, Port Tampa, Clearwater, and St. Petersburg.

BELLEFONTAINE, OHIO.—It is stated that the Dayton, Springfield & Urbana Railway will build a large power-house at West Liberty. The company is preparing to build its extension to Bellefontaine, and if built, the new station will furnish power for a large portion of the road. Right of way has been secured for the extension.

CAMBRIDGE, OHIO.—A company is being organized here with $500,000 capital stock to build a line from Cambridge to Byesville, a distance of ten miles. It will take over the stock of the Consolidated Ice & Electric Company and utilize its power house. O. E. Miles is the engineer in charge of the work.

DELAWARE, OHIO.—The Delaware, Berkshire & Sunbury Railway Company has been incorporated, with $10,000 capital stock, by J. T. Adams, J. E. Bierbauer, E. F. Gwynn, J. M. Schooles and P. J. Enbanks. The company was organized by a number of farmers in Delaware County and the road will operate wholly within the county.

CANTON, OHIO.—The annual meeting of the Canton-Massillon Railway Company was held recently. Officers were elected as follows: W. A. Lynch, president; G. W. Bodinot, secretary; L. A. Loichot, treasurer, and Charles Currie, general manager. The election was merely a formality, as it is understood that a deal has been practically closed for the transfer of the property to Tucker, Anthony & Company, of Boston.

MT. VERNON, OHIO.—On Feb. 1 the Mt. Vernon Street Railway Company and the Mt. Vernon Electric Light Company passed into the hands of the Jackson-O'Neill syndicate. Hereafter all three properties will be operated under one management. J. W. O'Neill, of Topeka, Kan., is president of the new company, and C. E. Johnson, secretary-treasurer and general manager. The new company will improve the street car lines and lighting plant.

CLEVELAND, OHIO.—The Everett-Moore syndicate will probably dispose of the Canton-Massillon Railway which was purchased some time ago, and the Akron-Canton Railway, which is held under option, and which was to have been turned over when completed. The first mentioned property includes the city lines of Canton and Massillon, an interurban line between the two towns and a line from Massillon to Navarre. The deal has not yet been closed up, but it is under consideration by the bankers' committee in charge of the Everett-Moore affairs.

CINCINNATI, OHIO.—Annual meetings of the Cincinnati & Eastern Railway, Suburban Traction Company and Rapid Railway were held a few days ago. The directors of the three companies are the same. Officers: Cincinnati & Eastern, G. R. Scrugham, president and general manager; Lee H. Brooks, vice-president; J. M. Kennedy, secretary-treasurer. The officers of the Rapid Railway are the same as the above, and those of the Suburban Traction Company are: G. R. Scrugham, president and general manager; J. M. Kennedy, vice-president; Lee H. Brooks, secretary, and Guy W. Mallon, treasurer.

OTTAWA, ONT.—Mr. Henry Burkholder, of Chicago, Ill., has recently been in Winnipeg, Man., completing arrangements for the commencement of work on the Lac Du Bonnet electric power plant. He states that the company he represents is also pushing forward the scheme of an electric railway from Lac Du Bonnet to Winnipeg, a distance of fifty-eight miles, the cost of which is estimated at $20,000 a mile.

OTTAWA, ONT.—It is now said that the Niagara Falls & St. Catherines electric railroad is to be extended toward Toronto next spring.

OTTAWA, ONT.—The report of the Dominion Department of Railways, at Ottawa, for the year ended June 30, 1901, a return is made, for the first time in the history of Canada, officially at least, of the electric railways of the Dominion. These total 675 miles of track. The paid-up capital of the electric railway companies is $39,076,019; gross earnings, $5,768,283; working expenses, $3,435,163; net earnings, $2,333,120. The street railways report the following number of passengers carried during the year: Montreal, 45,833,652; Toronto, 37,620,583; Ottawa, 7,469,304; Quebec, 3,715,675; Hamilton, 3,693,677; Winnipeg, 3,196,489; Halifax, 2,968,811; St. John, 1,710,223.

NASHVILLE, TENN.—C. W. Ruth and Frank Haskell, Pittsburg capitalists, have been investigating the question of constructing an electric railway from Nashville to Gallatin, thirty miles, and to Mt. Pleasant, fifty-eight miles. A charter has been applied for. The road will traverse the new Tennessee phosphate beds.

JANESVILLE, WIS.—The Janesville Street Railway Company's car barn was burned recently.

WAUPACA, WIS.—The Waupaca Electric Light & Railway plant was recently damaged by fire to the extent of $2,000.

MARINETTE, WIS.—The consolidation of the Marinette and Menominee street railway and lighting companies has been practically effected. The deal was made by Marinette and Menominee capitalists, who now own the stock of both lines. The new company will immediately complete a belt line around both cities, add new rolling stock and make other improvements, at a cost of about $100,000. The ultimate intention is to operate the system by power derived from water power located two miles up the Menominee River. The officers of the company are: President, F. A. Spies, of Menominee; vice-president, A. C Merryman, of Marinette; secretary, G. W. Hanley, of Marinette; treasurer, H. G. Brown, of Marinette; superintendent, Ed. Daniell, Menominee.

## NEW INDUSTRIAL COMPANIES.

THE F. P. JONES ELECTRIC COMPANY, of Buffalo, has been incorporated; capital, $10,000. Directors: Ferdinand P. Jones, Arthur A. Franklin and Charles D. Blackhall, Buffalo.

THE TICONDEROGA GRAPHITE COMPANY, Ticonderoga, N. Y., has been incorporated; capital, $100,000. Directors: W. W. D. Jeffers and W. W. Jeffers, Ticonderoga; H. B. Moore, New York.

## THE AUTOMOBILE.

THE OCTOMOBILE COMPANY was recently incorporated in San Francisco with a capital stock of $100,000. Directors: A. Keller, J. M. Peel, C. L. Tilden, J. A. Marsh and H. F. Peart.

FLAGSTAFF, ARIZ.—Mr. Oliver Lippincott, the Los Angeles artist, in his automobile "Toledo" has climbed Knob Hill, a 16 per cent grade, in six inches of snow, in a test before a committee of the new automobile company between Flagstaff and the Grand Canyon. The demonstration is considered one of the most successful and difficult ever given in this country.

AUTOMOBILE SHOW IN CHICAGO.—The Chicago automobile show will open at the Coliseum in that city, Saturday, March 1, and continue through the following week, closing March 8. This show will be under the joint auspices of the Chicago Automobile Club and National Association of Automobile Manufacturers. All the space in the Coliseum has been engaged.

THE AUTOMOBILE CLUB OF AMERICA will hold its annual dinner at the Waldorf-Astoria on March 7, when a number of prominent men are expected to speak. The indications are of a large attendance. The Banquet Committee comprises Messrs. J. M. Hill, chairman; S. H. Valentine, H. W. Hedge, J. C. McCoy, B. McGregor, H. K. Browning and A. H. Whiting.

THE CALIFORNIA MOBILE TRANSPORTATION COMPANY has been organized in San Jose, Calif. Col. W. J. Cotton, of Oakland, is president and general manager. The capital stock is $200,000. The company has a number of automobiles, which will be used to carry tourists on excursion trips. Connections will be made with the observation train, which the Southern Pacific Railroad Company will operate between San Francisco and Los Gatos.

## OBITUARY.

MR. E. E. QUIMBY.—Mr. Edward Everett Quimby, who died last week at Orange, N. J., was an inventor of signal ability and a patent expert, who stood at the head of his profession in this country. He was born in Bangor, Me., on February 9, 1831. He was engaged in business with his father until 1860, when he invented the screw machine still used by the American Screw Company. He became superintendent of the plant of that company, and remained with it until 1866, when he branched out for himself, and opened an office as a patent expert. Among the notable cases Mr. Quimby was engaged in was the patent litigation between the Bell Telephone Company and the Western Union Telegraph Company. His specifications for the Mannesmann tube patents were bound and issued by the Patent Office as a model for the guidance of other applicants for patents. His private charities were numerous, and during his career he took out many patents for poor inventors who were unable to pay the necessary charges. His death was caused by an attack of malaria, brought on by overwork. He is survived by his wife, two sons, and four daughters.

## PERSONAL.

MR. THOS. A. EDISON, we understand, was invited to breakfast with Prince Henry of Prussia on board the Imperial yacht "Hohenzollern" on Feb. 27.

MR. ROBERT McF. DOBLE, of San Francisco, is in British Columbia, engaged as consulting electrical engineer in the examination of hydro-electric projects for the City of Vancouver.

MR. FRED. W. C. BAILEY, consulting electrical engineer of Columbus, Ohio, has been in New York the past week in connection with the design and purchase of apparatus for some plants on which he is engaged.

MR. H. A. WOODS, who has long acted as chief electrician of the Independent Electric Light & Power Company's system in San Francisco, has been advanced to fill the vacancy occasioned by the resignation of Mr. R. S. Masson as superintendent. Mr. Woods was at one time connected with the San Gabriel Electric Company in Los Angeles, and was graduated from Stanford University.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the interests of the Westinghouse Electric & Manufacturing Company, Westinghouse, Church, Kerr & Company, and a number of other North American concerns in Chili, Peru, Bolivia and Ecuador, is now on a visit to the United States. He can be found at the offices of William E. Peck & Company, 100 William Street, New York City.

MR. ARTHUR F. STANLEY, one of the oldest and best known electrical manufacturers in New York City, has recently severed his connection with the firm of Stanley & Patterson, and has opened offices in the Havemeyer Building at 26 Cortland Street, where he proposes to handle leading electrical specialties. He has already returned from a western trip, on which he completed arrangements for representing the Warren Electric & Specialty Company. Mr. Stanley has a wide circle of friends and acquaintances in the industry and is receiving many evidences of their hearty support.

MR. JAS. R. CRAVATH, western editor of ELECTRICAL WORLD AND ENGINEER, lectured before the electrical engineering students of Lewis Institute, Chicago, the evening of Feb. 20, on High Voltage Transmission. The lecture was illustrated with demonstrations by the current of a 30,000-volt testing transformer, showing the effects obtained with high voltages and the points to be guarded against in the construction of high voltage lines. The lecture was, in fact, a resume, as far as the short time would permit, of current practice in the far West.

MR. G. MARCONI.—The March issue of *Success* opens with an interesting analysis of the life-work of Guglielmo Marconi, written by Herbert Wallace, a well-known authority on scientific matters who, for the past three years, has followed Mr. Marconi in his many undertakings. Mr. Wallace reveals to us the qualities that made the young inventor finally successful in flashing the message across the Atlantic Ocean without a wire, and shows that Mr. Marconi, during his many years of experiment, overcame obstacles that one might suppose would make the most optimistic and courageous give up.

## Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agents for the Sangamo Electric Company, has just published a most complete meter catalogue, or book of information, dealing with the Gutmann integrating alternating current wattmeter. It will be sent upon application to those interested and is worth sending for.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has recently completed its second factory for the manufacture of "Fostoria Inner Globes, Extra Quality," and incandescent lamp bulbs. This company claims the unique distinction of being the only lamp manufacturer which manufactures its own globes.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, reports that the insulating of wire and cable is quite an extensive business with it. The insulating and cable machines run along day and night and have done so since last summer. The daily output keeps the factory supplied while the surplus is supplied to the trade.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, is preparing to build two additions to its plant. One building two stories high measuring 42x32 will be used for a filament and laboratory department and another building two stories high and 125x48 feet will be used for storage purposes. Work will start at once.

COAL HANDLING MACHINERY is the subject of a 32-page pamphlet issued by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y., containing a brief description of the machinery of this class manufactured by this concern. The pamphlet is illustrated and will be perused with interest by those concerned in coal handling.

BUCKEYE LAMPS.—The Buckeye Electric Company, Cleveland, Ohio, reports a very prosperous business in Buckeye lamps during the past season, during which time it has added to its line of manufacture a complete line of special lamps. The new type Buckeye lamp has maintained its reputation and is stated to have kept abreast in the development of the incandescent lamp from the earliest times.

KELLOGG PHILADELPHIA OFFICE.—The Kellogg Switchboard & Supply Company, of Chicago, has opened a branch office in Room 204 Keystone Telephone Building, corner Second and Sansom Streets, Philadelphia, where a full line of samples will be on exhibition, and where any information regarding business matters generally connected with the company will receive prompt attention.

THE REYNOLDS ELECTRIC COMPANY, of 221-225 Fifth Avenue, Chicago, has recently added valuable improvements to its "flasher" which it claims have made it the simplest, most durable, most reliable and consequently the most satisfactory on the market. "The Improved Reynolds Flasher," as the company has named it, is being heartily welcomed by the trade everywhere, and no doubt will be a great success.

THE AMERICAN INSULATING MACHINERY COMPANY, 940 North Third Street, Philadelphia, Pa., has recently made a number of improvements in its winding machinery which have greatly increased its efficiency. These improvements are particularly noticeable in the flyer, the perfected type of which has been given a thorough trial by a number of large manufacturers and pronounced satisfactory in every way.

FINISHED CASTINGS WITHOUT MACHINE WORK.—The H. H. Franklin Manufacturing Company, Syracuse, New York, has a process of casting metals which avoids the necessity of subsequent machine work. In a pamphlet issued by the company some information concerning the work is told in the fewest number of words possible, a la Alfred Jingle. All interested in castings would do well to look into this company's work.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that the demand has become so great for its new Wesco dry battery, which it has recently placed on the market, that it is hardly able to fill orders for it. It goes so far as to claim that this battery has the highest voltage, greatest current discharge, most rapid recuperation and longest life of any such battery on the market. It is sending them out on trial on application.

THE UNION ELECTRICAL & SUPPLY COMPANY has been organized in Salt Lake City. This concern, which is co-operative in character, has been established by the Electrical Workers' Union, whose members have been on strike and could not come to any agreement with the contractors. The new concern has sent orders for material and supplies to start a business with. The president is H. Scheiber, and the secretary and treasurer, H. Johnston.

CLEVELAND ENGINEERING COMPANY has opened an office at 817 New England Building, Cleveland, Ohio, where it is prepared to furnish estimates and specifications, to superintend the installation and make final tests of plants for power transmission, for lighting, heating and ventilating, storage battery equipment and electric railways. It will also make efficiency tests on existing plants. The members of the concern are Messrs. H. W. Woodward and C. H. Benjamin.

MR. WILLIAM ROCHE, 42 Vesey Street, New York City, is receiving orders from all quarters of the globe for his "New Standard" flashlight. The most important feature of this useful article is its long life, and wherever used it has given satisfaction. The various other specialties made by Mr. Roche, namely, the auto-gas ignition outfits and electric gas lighter, are meeting with good demand, all of which is due to the use of the "New Standard" dry battery, so well known for its length of life.

AMERICA'S WINTER RESORTS is the title of "Four-Track Series," No. 5, just issued by the New York Central & Hudson River Railroad Company. It refers briefly to the various American winter resorts and gives all the information that a traveler wants concerning these places. It contains several excellent maps, covering the greater part of the world, and altogether is a very interesting addition to the "Four-Track Series" of folders. Mr. George H. Daniels, General Passenger Agent, will be glad to send a copy to any one on receipt of a two-cent stamp.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., has just completed and placed upon the market a complete line of drum controllers for printing presses, cranes, hoists, machine tools, etc. These controllers are built in several different types, one very novel design embracing control through both armature and field of the motor, as well as no-voltage and overload release. Descriptive bulletins have been published and are being distributed. The company reports that its business during the past year was double that of 1900 and that it is constantly increasing its facilities to keep up with the ever growing demand for its goods.

THE OSBURN FLEXIBLE CONDUIT COMPANY, of New York, is making rapid progress with the new buildings in the extension of its manufacturing plant in Hoboken, N. J. The new addition will more than double the present capacity, and is expected to be completed in a couple of months. The business that has come to this company for its product "Flexduct" has been most gratifying and has exceeded all expectations, but the company does not propose to be one of "delay in delivery" kind, and is making these additions to its plant to enable it to fill all orders promptly.

HAND TRAVELLING CRANES.—Messrs. Pawling & Harnischfeger, Milwaukee, Wis., describe and illustrate a line of hand travelling cranes in Bulletin No. 5, recently issued. These hand cranes are furnished in two types of trolleys, Type A being made to be operated from a floor through or by means of pendant chains, and are built in capacities from 3 to 10 tons; Type C trolleys are made for lifting loads varying from 10 to 40 tons, the operation of hoisting being effected by hand cranks. It should be noted in this connection that the manufacture of hand travelling cranes by this firm is a secondary feature of the business, the main portion of its output being electric travelling cranes.

TRANSFORMER EFFICIENCY.—The Pittsburg Transformer Company has issued a pamphlet entitled, "Ultimate Efficiency of Transformers," which will be found of much interest to users of transformers. The subject is considered, not, as is usual, from the standpoint of electrical and magnetic design, which are assumed to be correct, but with respect to the mechanical and other features. Under these heads are considered insulation, internal temperature, construction, workmanship and operation, the importance of which are pointed out as affecting ultimate efficiency, which is defined as the relation between earnings and total expense, including purchase price, during the entire life of a transformer.

SCRANTON ENGINEERS' CLUB.—At the annual meeting, on Jan. 23, 1902, of the Engineers' Club, Scranton, Pa., the following officers for the ensuing year were elected: President, H. H. Stoek; vice-president, B. F. La Rue, Professor of Civil Engineering in the International Correspondence Schools; secretary, A. E. Lister; treasurer, F. J. Platt; corresponding secretary, A. B. Dunning; librarian, H. M. Lane, Professor of Mechanical Engineering in the International Correspondence Schools; directors, W. M. Marple, C. C. Rose, and H. W. Rowley. President Stoek is the editor of *Mines and Minerals*, the well-known mining publication issued by the International Textbook Company, Scranton, Pa., proprietors of the International Correspondence Schools.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, Ohio, has just issued two catalogues, one on the subject of power pumping machinery, and the other on Stilwell heaters. The former catalogue gives descriptions and many illustrations of triplex and duplex electric gas or gasoline pumps and combined water-wheels and pumps for general water supply, municipal water works, hydraulic elevator service, mine service, railway service, etc. The illustrations, which are mainly halftones, are very clear in detail, and several full-page views show actual installations of pumps. The Stilwell heaters are treated in the second catalogue in a very complete manner, and fully illustrated. Reproductions of testimonial letters from many users of these heaters are given at the back.

THE STUART-HOWLAND COMPANY, of Boston, reports a remarkable growth in all departments of its business. Its sales in the last year show an increase of 120 per cent over the previous year. In the street railway department it has been particularly prosperous, having furnished in the season of 1901, in addition to its general supply business, the entire overhead and pole equipment (excepting wire) for over 500 miles of new road. It now manufactures this complete line, and has already several large orders booked for delivery the coming spring. It carries a very complete stock of all kinds of electrical supplies except heavy machinery, and has now ten salesmen on the road. It has recently issued a 332-page, 8″x8″ general electrical supply catalogue, handsomely bound in cloth, in which everything is listed alphabetically, and very generously illustrated. It is printed on 70-lb. coated, natural tint paper. Both print and illustrations are unusually distinct, and as practically everything is shown which contractors, supply dealers, street railways, telephone companies, central stations and isolated plants have to purchase, it must prove decidedly popular in the purchasing departments of the various branches of the electrical trade.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, is in receipt of a great many inquiries relative to cedar poles and the indications are that the business will be very brisk, and even greater than last year. The company entered the field about January of last year and secured from producers in the vicinity of Escanaba, Mich., a very large stock of white cedar poles, with an idea of furnishing them to telephone companies in connection with its switchboard and telephone business. It supplied a large number of poles for the independent plants at Jackson and Detroit, Mich., Columbus, Alliance and Canton, Ohio; Iowa, Indiana, Illinois and the Southwestern States also purchased a large proportion of the stock. It was, of course, an experiment for a telephone manufacturing company to take up a distinct branch such as the pole business, but the results were so satisfactory and worked in so well with its general business that it has decided to continue for another year. It is stated that poles have advanced this year, but the company is said to have quite a number of poles that were bought last year, and is able to make very attractive prices on them. The company has a very complete assortment of poles and in yards whose shipping facilities can not be equalled. They have several large yards on the C. & N. W. R. R., the Escanaba & Lake Superior Railroad, and the same on the D. S. S. & A. R. R., also a very large yard at Ontonagon, Mich, on the C., M. & St. P. R. R.

STORE WINDOW REFLECTORS.—Any merchant given to reflection recognizes that his show window display is as important an advertising medium as are the local papers in which he sets forth in printed form the merits of his goods, and he will as readily see the importance of having his display lighted up to best possible advantage, now that the artificial lighting of show windows at night has come to be a feature of the shopper's world. A lighting system which has come to the front as meeting every requirement of window lighting is that of Frink's special patent window reflector, which has been installed in the show windows of a large number of the finest stores in the country with the highest possible results. Among the stores more recently adopting same might be mentioned: Eastman Bros. & Bancroft, Portland, Me.; Edward Malley & Company, New Haven, Conn.; Geo. Muse, Atlanta, Ga.; Kauffman, Strauss & Company, Lexington, Ky.; W. R. Bennett Company, Omaha, Neb.; Parker, Lowe D. G. Company, Fort Worth, Tex., and the windows of Messrs. Burke & Company's Norfolk, Va., store, this firm having recently installed it in their Dallas, Richmond, Memphis and Nashville stores also. Messrs. Kaskel & Kaskel have installed it in the show windows, and also the show cases, of their fine, new Fifth Avenue store, New York, and Messrs. H. C. F. Koch & Company, New York, and Callender, McAuslan & Troup Company, Providence, R. I., have installed a modification of the same with fine effect in lighting up their art department.

EXHAUST STEAM HEATING.—The American District Steam Company, Lockport, N. Y., reports that great interest is being taken by electric companies in the subject of the utilization and sale of exhaust steam from engines, by means of the American District system of underground steam mains. The company is in receipt of twice the number of orders at this time of the year over any previous year, and also a large number of inquiries from electric companies in all parts of this country and abroad. The subject of direct and exhaust steam heating, it states, is being taken up by electric companies and the public generally. Electric companies find that by installing this system of underground mains they can secure a large amount of additional electric lighting and power in large buildings that formerly generated their own current, as they are then able to furnish such buildings with steam heat from the street mains and electrical energy from the central station. One of the largest heating plants that the American District Company has ever installed was built for this particular purpose. In order to secure the electric business in several large blocks, the electric company was compelled to furnish the steam for heating these buildings. Owing to the rapid increase of the electrical business and the installation of more boiler and engine power, the American Company considers it much more preferable, and a good deal cheaper, to utilize the exhaust steam in electric plants in the manner above outlined, than to develop some water power, which is liable to run dry part of the year, and require a steam plant in reserve. The company contemplates large additions to its manufacturing plant the coming season to take care of its increasing business.

# Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 18, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

11,968. REISSUE—ELECTRIC CONTACT OR CURRENT TAKING DEVICE; E. Greil and E. Audiger, Paris, France. App. filed Aug. 9, 1901.

This patent and the two which follow cover different forms of contact in which one terminal consists of a bunch of metallic wires, or other finely divided metal, while the other terminal is a point, or points adapted to pass into the body of such material.

11,969. REISSUE—ELECTRIC CONTACT OR CURRENT TAKING DEVICE; E. Greil and E. Audiger, Paris, France. App. filed Aug. 9, 1901. (See No. 11,968.)

11,970. REISSUE—ELECTRIC CONTACT OR CURRENT TAKING DEVICE; E. Greil and E. Audiger, Paris, France. App. filed Aug. 9, 1901. (See No. 11,968.)

693,390. ELECTRIC SIGNALING APPARATUS; F. B. Herzog, New York, N. Y. App. filed Oct. 19, 1886. An electrolytic receiver comprising a cylinder-surface and a bath-reservoir, co-operating with a portion only of the surface.

693,394. SECTIONAL CONDUCTOR ELECTRIC RAILWAY; K. Hora, Pardubitz, Austria-Hungary. App. filed March 6, 1901. The naked conductor in a closed conduit is surrounded by metal rings at intervals which are lifted by a magnet, carried by the car, into contact with the roof of the conduit, to establish connection from the conductor, through the ring, the conduit roof, to the motor.

693,396. AUTOMATIC RAILWAY APPLIANCE; S. W. Huff, Baltimore, Md. App. filed Jan. 17, 1898. A depressor bar operated by the flange of the car wheel and being of such length that when once pressed down to close the circuit, there will always be a flange upon it to hold it down until the entire train has passed, thus preventing intermittent closures of the circuit.

693,398. CONDUIT BUSHING; H. Ill, Newark, N. J. App. filed Nov. 23, 1901. A bushing adapted to be clamped to the end of the conduit and engaged with the walls of the outlet box.

693,408. METHOD OF MANUFACTURING SUGAR; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed May 19, 1900. (See Current News and Notes.)

693,410. SUSPENSION CLAMP FOR ELECTRIC CONDUCTORS; S. S. Leonard, Chicago, Ill. App. filed Oct. 12, 1901. A bracket having a seat and clamp for the suspension wire.

693,416. CIRCUIT BREAKER; F. A. Merrick and J. D. Forrer, Johnstown, Pa. App. filed Nov. 9, 1899. A chamber formed by bottom and side walls of refractory material contains fixed contacts with which a movable contact co-operates; a division plate is located in the chamber and the whole structure is surrounded by a magnetic field.

693,417. SELF-PLAYING MANDOLIN; A. I. Mitchell, Rumford Falls, Me. App. filed April 4, 1901. Separate magnets are used to fret and pick the strings, a single circuit closer operating both magnets simultaneously.

693,425. OVERFLOW ALARM; A. Nicolet, Newark, N. J. App. filed Aug. 20, 1901. Details.

693,453. SECONDARY BATTERY PLATE; W. L. Silvey, Dayton, Ohio. App. filed Jan. 10, 1901. A corrugated plate filled on both sides with the active material is rolled up into a plug and pressed into a cavity in the plate.

693,482. METALLURGICAL PROCESS; E. G. Acheson, Buffalo, N. Y. App. filed Oct. 14, 1899. (See Current News and Notes.)

693,491. ALTERNATING CURRENT MOTOR METER; H. Brockelt, Berlin, Germany. App. filed Aug. 17, 1900. Details.

693,495. CARBON FEEDING DEVICE; C. E. Chapin, Greenwich, and W. E. Patchin, Bridgeport, Conn. App. filed May 4, 1901. To control the feed

the controlling magnet moves a roller into and out of contact with the side of the rod, thus creating or reducing friction thereon.

693,520. RAILWAY ELECTRIC SIGNALING APPARATUS; W. Hume, London, England. App. filed May 28, 1901. Details.

693,530. MULTIPLEX TELEGRAPH CIRCUIT; L. A. McCarthy, Brooklyn, N. Y. App. filed April 24, 1901. The system includes a main and an artificial line and a controlling instrument, the coils of which are inserted in the two lines, to automatically actuate a rheostat to maintain a balance of resistance on the two lines.

693,537. ALTERNATING CURRENT ELECTRIC METER; E. Batault, Geneva, Switzerland. App. filed March 15, 1901. A magnetic bridge is employed between the two branches of the shunt magnet by means of which a partial closing of the magnetic lines of force is obtained to diminish the number of lines which affect the armature.

693,542. AUTOMATIC SHUT-OFF FOR ELECTRIC PUMPS; J. H. Fox and C. M. Lowther, New York, N. Y. App. filed Dec. 4, 1901. The fluid pressure in an expansible coil controls an electric switch.

693,550. ELECTRICAL SWITCH MECHANISM; H. Krantz, Brooklyn, N. Y. App. filed May 8, 1901. Details of construction of the clips.

693,555. LIGHTNING CONDUCTOR; A. Lelong, Villers Poteries, Belgium. App. filed Nov. 1, 1901. The conductor comprises a wire connected at its upper end to a conducting head having a series of spikes and at its lower end to a spiral copper coil, also having spikes.

693,578. CONDUCTOR FOR ELECTROMAGNETIC INDUCTION APPARATUS; H. H. Wait, Chicago, Ill. App. filed Jan. 12, 1901. Armature conductors are made of two different cross sections, the portion having the smaller cross section resting in a groove of the armature, while the larger occupies the dead portion at the heads, the object being to make the armature proper smaller in circumference than heretofore.

693,579. WINDING FOR DYNAMO ELECTRIC MACHINES; H. H. Wait, Chicago, Ill. App. filed Jan. 12, 1901. A modification of the preceding.

693,597. APPARATUS FOR CONTROLLING ACTIONS AT A DISTANCE; J. Gardner, Fleetwood, Eng. App. filed Dec. 30, 1901. (See Current News and Notes.)

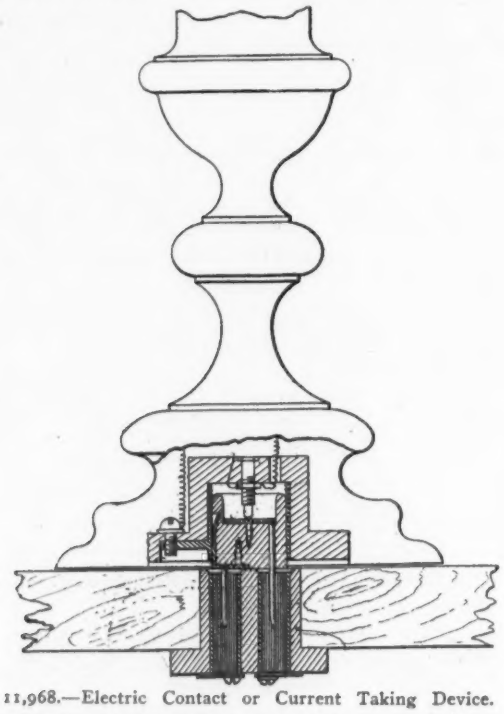
693,603. THIRD RAIL INSULATOR FOR ELECTRIC RAILWAYS; C. M. Hobbs, Baltimore, Md. App. filed July 24, 1901. The insulator is held between plates which have projecting tongues interlocking with dovetailed openings in the insulator.

693,605. TELEGRAPH; F. E. D'Humy, Boston, Mass. App. filed Oct. 14, 1901. The balance of the artificial line is automatically changed to suit the different conditions set up by the respective polarities of current, by which a perfect balance is maintained with either pole of the battery to line.

693,636. ELECTRIC SWITCH; H. P. Ball and L. Wintner, New York, N. Y. App. filed March 5, 1901. A small blade enters the clip ahead of the large blade and being connected with the latter through a spring, it leaves the clip suddenly, after the main blade has been pulled away.

693,650. AUTOMATIC SIGNAL APPARATUS FOR LIQUID HOLDING TANKS; J. E. Johnson, Brooklyn, N. Y. App. filed July 31, 1901. A float actuated circuit closer.

693,663. ELECTRIC ARC LAMP; S. M. Meyer, Brooklyn, N. Y. App. filed May 9, 1901. Details.



11,968.—Electric Contact or Current Taking Device.

693,676. STORAGE BATTERY SEPARATOR; G. M. Willis, Chicago, Ill. App. filed Aug. 10, 1901. The separator is made up of glass wool, stitched together with fibres of asbestos.

693,678. MACHINE FOR PRODUCTING CHLORIN GAS AND CAUSTIC SODA FROM COMMON SALT; G. M. Wilson, Sault Ste. Marie, Canada. App. filed Sept. 20, 1901. (See Current News and Notes.)

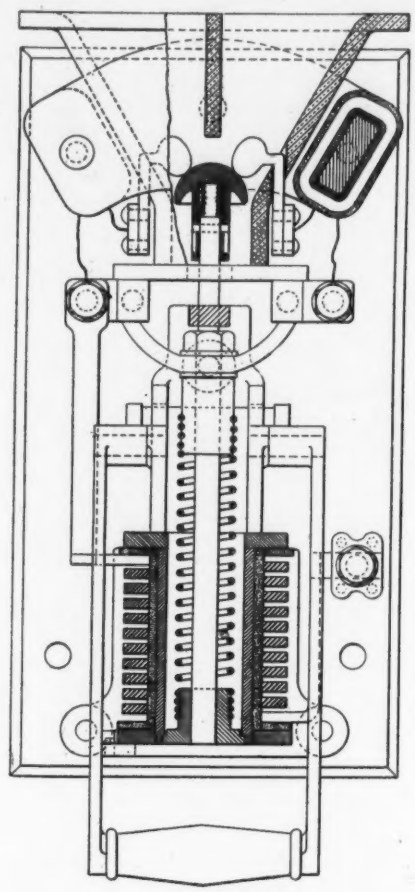
693,688. ELECTRIC METER; C. T. Claypoole, Sioux City, Ia. App. filed Jan. 6, 1902. In case the meter runs backward a fuse is automatically blown.

693,692. RESISTANCE COIL; A. C. Eastwood, Cleveland, Ohio. App. filed Sept. 26, 1901. The coils are wound around magnetic cores which are so placed that the magnetic field created by them will blow out any arc that may form between the buttons of the resistance.

693,705. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed July 12, 1901. Details.

693,706. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Oct. 3, 1901. Details.

693,738. ELECTRIC LAMP SOCKET; J. D. Pierce, Philadelphia, Pa. App. filed Jan. 4, 1901. The shell which receives the neck of the lamp engages



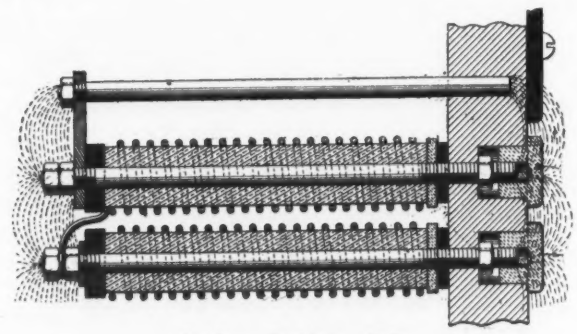
693,416.—Circuit Breaker.

with a porcelain disc by means of a lip which enters a notch in one edge of the disc, and a screw which passes through the disc and enters a flange on the base of the shell.

693,752. ELECTRIC COIL; W. Spencer, Jr., Schenectady, N. Y. App. filed Dec. 26, 1901. For purposes of ventilation the coil is made compound, an inner coil consisting of a series of windings spaced apart.

693,757. STORAGE BATTERY; W. Taylor, Philadelphia, Pa. App. filed July 28, 1900. The perforations in the plate have burrs extending in opposite directions and so shaped as to cause interlocking with the active material.

693,784. TRANSFER-BOARD FOR TELEPHONE OR TELEGRAPH CIRCUITS; A. B. Chance, Centralia, Mo. App. filed July 25, 1901. (See page 396.)



693,692.—Resistance Coil.

693,791. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, Ohio. App. filed Oct. 21, 1901. Details.

693,799. PULL SOCKET; H. Hubbell, Bridgeport, Conn. App. filed July 24, 1901. A pull chain passes into an opening in the side of the socket and around a segment which is moved in one direction by the chain and in the opposite by a string.